MACHINERY.

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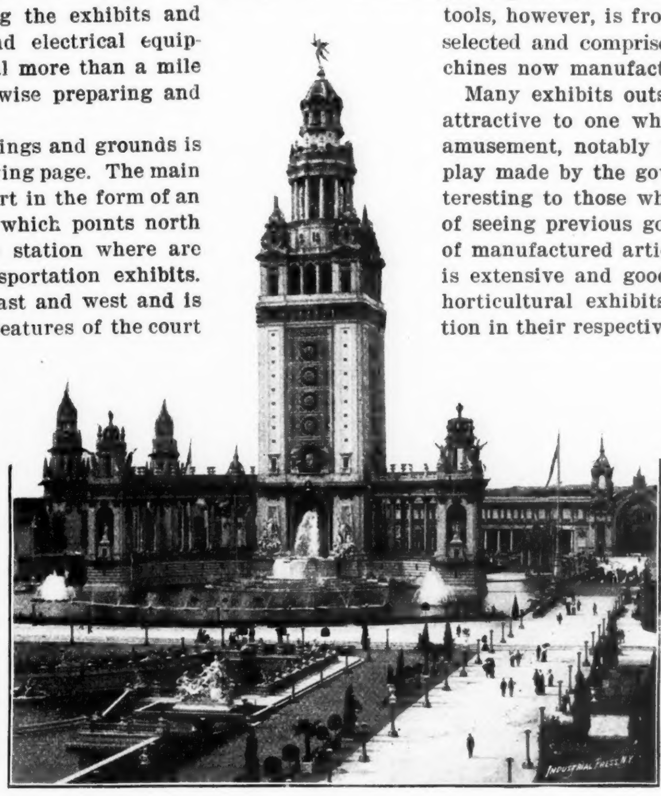
THE PAN-AMERICAN EXPOSITION.

GENERAL NOTES UPON THE EXPOSITION AND THE ENGINEERING EXHIBITS.

Entrance to Machinery Building.

THE grounds of the Pan-American Exposition are located in the northern part of Buffalo and adjoin the city park, which affords a beautiful and picturesque setting for the exposition. The site is within the city limits and is easily accessible by trolley or by the belt line of steam railway that encircles the city. An area of about 350 acres is included in the plot, its dimensions being one mile long north and south and half a mile wide east and west. Work was begun on the buildings and grounds only nineteen months before the opening day and consisted not only in erecting the buildings, securing and placing the exhibits and completing the mechanical and electrical equipment, but in excavating a canal more than a mile long, creating lakes and otherwise preparing and ornamenting the grounds.

The arrangement of the buildings and grounds is shown in the map on the following page. The main buildings surround a broad court in the form of an inverted letter T, the stem of which points north and terminates in the railway station where are also located most of the transportation exhibits. The cross arm of the T runs east and west and is known as the Esplanade. The features of the court are the Triumphal Bridge, situated south of the Esplanade, the Court of Fountains north of the Esplanade and finally the Electric tower, which is the masterpiece of the exposition, whether viewed by day, when its majectic proportions and delicate coloring enchant the eye, or by night, when its myriads of electric lights give the most brilliant illumination ever attempted. The tower is 8 feet square at the base and 375 feet high; elevators run to a point near the top. The largest buildings are the machinery and the liberal arts buildings. These each have a floor area of about four acres, and the exhibits in both departments have overflown to other quarters. "The lay of the land" and the location of the most important buildings can better be obtained by consulting the accompanying map and engravings than by attemping to follow a general description. The style of architecture is Spanish Renaissance, in honor of the Latin-American countries of the Western Hemisphere, and the details have been worked out with great care, both in the exterior and to a considerable extent in the interior. The buildings are mostly wooden structures, covered with staff.



The Electric Tower, 375 feet High, which is the Main Architectural Feature of the Exposition.

It can justly be said that the exhibits at the Pan-American Exposition are entertaining as a whole, many of them are instructive and others are surprisingly complete. It cannot be denied, however, that some of the exhibits are also disappointing to one who expects to find representative and comprehensive displays of the products and methods of the various branches of industry. Taking the machinery exhibits for illustration, those of wood-working machinery are singularly deficient. There is scarcely anything in the line of refrigerating machinery; agricultural machinery plays an unimportant part, and the same is true of textile machinery and numerous other lines. Machine tools occupy more space than any other one class of machinery, and the exhibits of these may be said to be fairly representative of the products of American machine tool builders. At the same time, only a small part of the firms in this country engaged in manufacturing tools and appliances for the machine shop have space in Machinery hall. There are perhaps 20 new machine tools shown, but very few of these can be classed as really novel or as departing from the usual practice. The collection of tools, however, is from well-known firms, is carefully selected and comprises many of the best modern machines now manufactured in the United States.

Many exhibits outside the machinery building are attractive to one who wishes instruction as well as amusement, notably the mining exhibit and the display made by the government, which is intensely interesting to those who have not had the opportunity of seeing previous government exhibits. The display of manufactured articles in the liberal arts buildings is extensive and good of its kind. Agricultural and horticultural exhibits naturally receive much attention in their respective buildings, since these branches of industry are important in all the countries of North and South America.

Many visitors at Buffalo, who have also been to the expositions at Chicago and Paris, attempt to institute comparisons between the latter two and the Pan-American Exposition. This, we think, is a mistake. The Pan-American Exposition is in no sense a world's fair, and no pretense is made that it does more than represent the industries and development of the countries of the Western Hemisphere. Certain exhibits may or may not equal those shown at the larger exposition and most of them probably do not, in extent, at least. This does not change the fact that the Pan-American Exposition is well worth seeing, is a great and creditable show, and that in the features upon which special efforts have been directed it is an unqualified success. In the way of amusements the immense Stadium, seating 12,000 people, is to be the scene of

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daily sports; there is good music to be heard at all hours of the day, and the Midway appears to please all classes and ages.

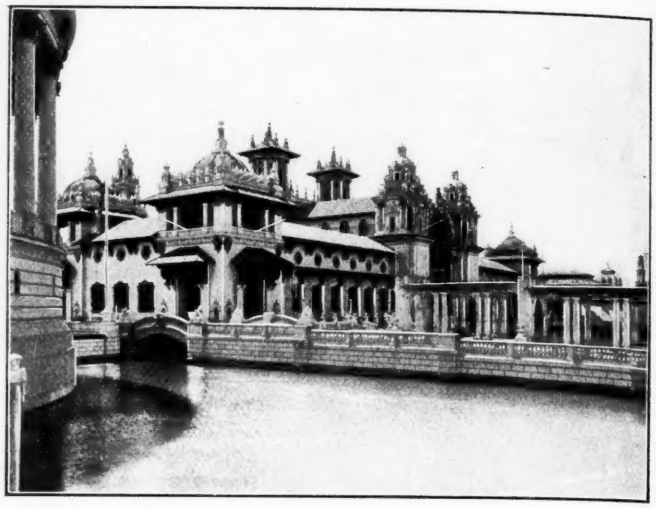
It has been claimed by the directors that the architectural and sculptural effects, the unity of the buildings and the harmony of their coloring, when considered as a group in

Machinery and Transportation Building, Court of Fountains in the Foreground.

which each is related to the others, would surpass anything previously attained. This, we believe, is true. Unfortunately, the most accessible entrances to the grounds are so situated that one usually enters from the side and does not obtain a view of the buildings that would most deeply impress him with their beauty. Once, at least, one should approach the grounds from the park, cross the Triumphal Bridge, and study the wrought out conceptions of the artists, sculptors and architects who are responsible for the "rainbow city."

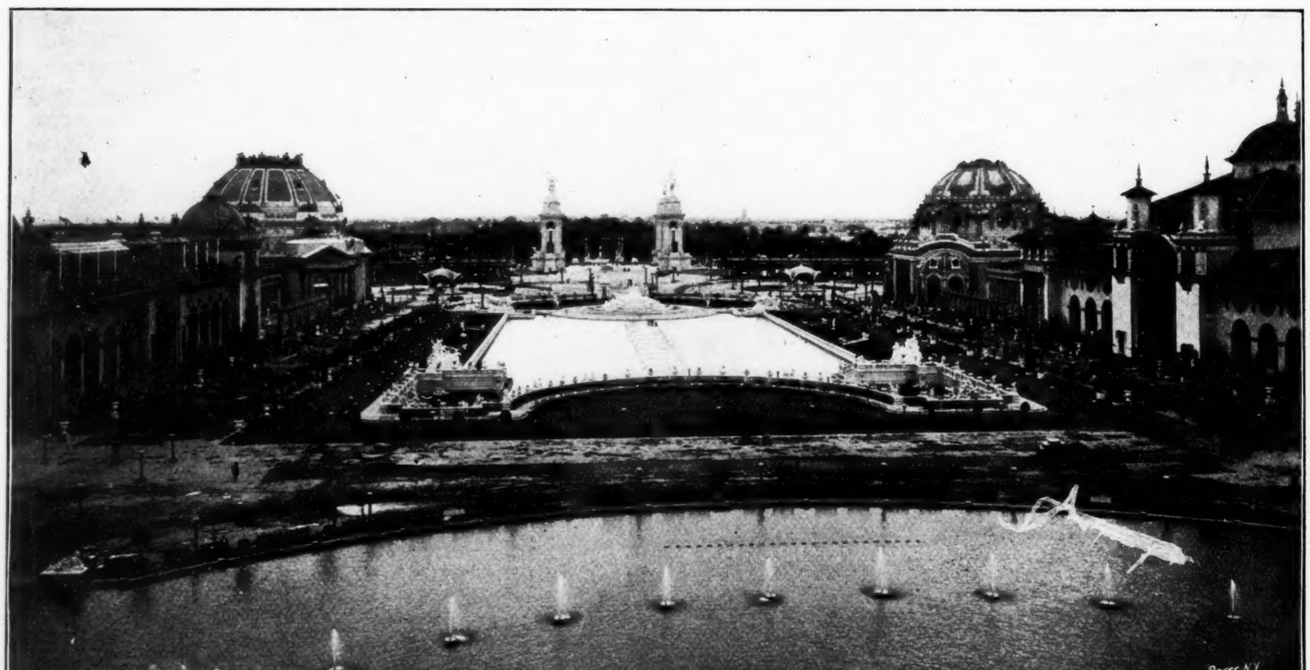
While the beauty of the buildings by day is to many one of the chief charms of the Pan-American Exposition, it is by

than to give the effect of individual and brilliant dots of light. There are over half a million of these lamps on the buildings and lamp posts of the grounds, and there are 40,000 on the Electric Tower alone. The illumination of the tower is distinctively the feature of the exposition, although the main buildings and the Triumphal Bridge present a striking appearance when illuminated. Second only to the Electric Tower with reference to the spectacular are the illuminated fountains. In the north bay of the lake in the park is an electric fountain located on an island at the center, underneath which is a chamber with electrically operated pumps. There are over 100 jets in the fountain, and various combina-



Electricity Building.

tions can be obtained. Twenty-two arc projector lamps are employed in the illumination. The Court of Fountains, lying at the foot of the tower, is brilliantly illuminated, both with colored lights and search lights, and at other locations on the grounds there are fine fountain displays, although secondary to those already mentioned.

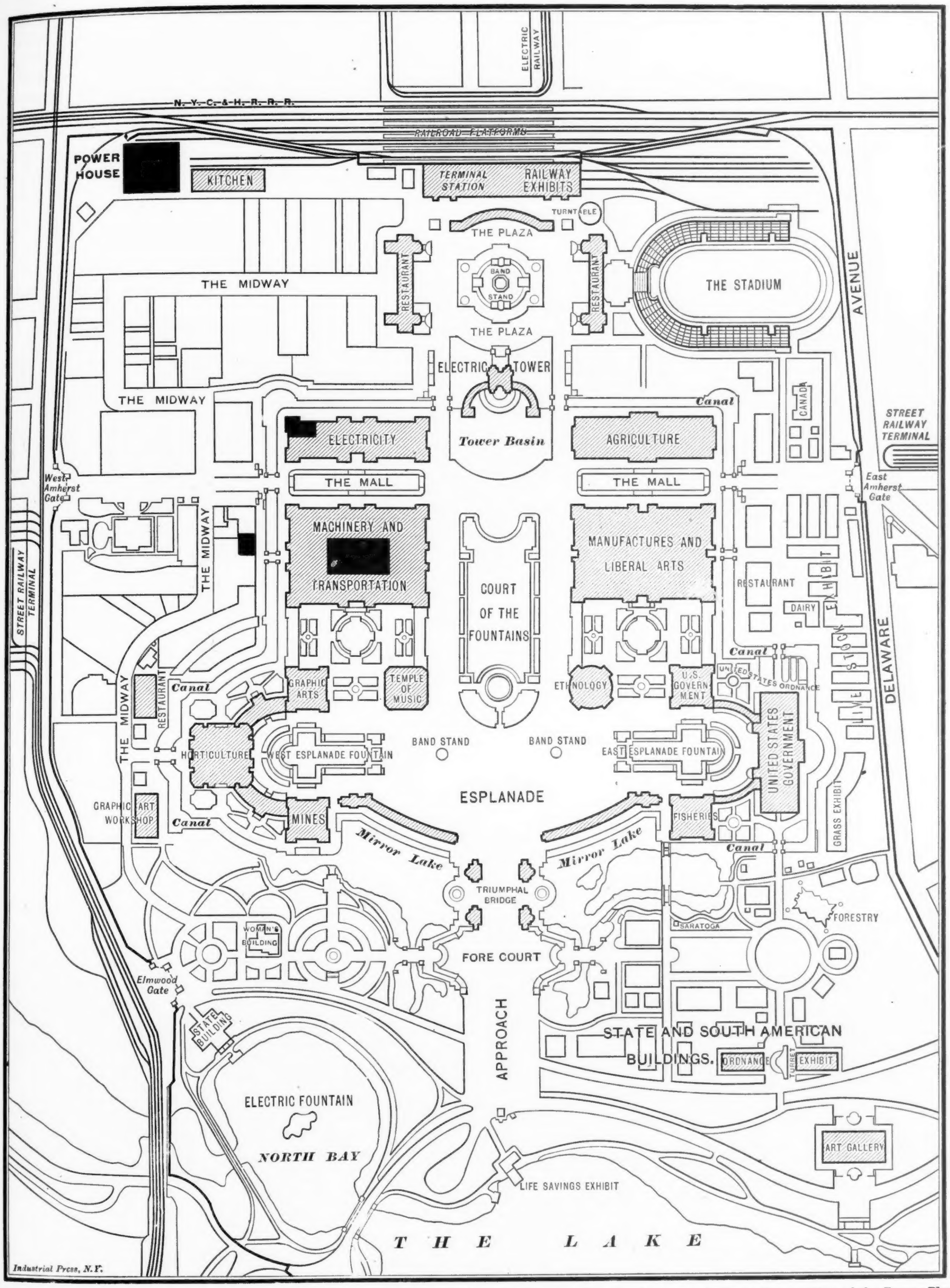


Looking toward the Triumphal Bridge from the Electric Tower. The Domed Structure at the left is the Ethnology Building, and the one at the right, Music Hall. At the extreme left is the Liberal Arts Building; at the extreme right, Machinery Building. The Court of the Fountains is at the center.

night that the grounds and buildings attain their full glory. No such spectacle would be attempted anywhere else in the world at the present day. No such extravagant outlay of lights would be thought of where the power had to be furnished by coal and steam. The lighting is mainly by 8-candle-power incandescent lamps, this size being selected to soften the effect and produce a brilliant glow over the whole, rather

The Engineering Features.

The various power plants of the exposition are indicated by the black squares on the map on page 339. Of these the most important is the transformer plant in the electricity building. It is here that the electric energy is received from Niagara and distributed for all the electrical decorative purposes and the general illumination of the grounds. The current, as it is



Map of the Pan-American Exposition Grounds, showing the location of the Main Buildings. The black spaces indicate the position of the Power Plants mentioned in the Text.

brought from the transformer station at Niagara to Buffalo, is a three-phase 22,000-volt current. At Buffalo it passes through another set of transformers, which reduce it to a voltage of 11,000. At this voltage it is carried by another transmission line and conducted to the grounds of the Pan-American Exposition, where, after passing underground, the cables reach the Electricity Building and the transformers again reduce the current, this time to 1,800 volts, at which it is distributed about the grounds, being still further reduced at various points for use at the lamps. The transformer plant in the Electricity Building has a capacity of over 5,000 horse-power.

At the extreme northwestern limit of the grounds, beyond the paths of travel of the usual visitors, is the service power plant, which was erected at first to supply the power needs of the grounds during the construction of the buildings. It is still used for lighting the buildings of the Midway, for power purposes at isolated points and for arc lighting. The apparatus is mainly such as could be obtained for temporary

needs and much of it is second-hand and was not installed for exhibition. This station has an aggregate of 3,500 horse-power. At one corner of the building is a fireproof structure containing three Snow fire pumps under steam all the time, and which maintain a constant pressure in the mains reaching to different parts of the grounds. The provision for fire protection is very complete. The Snow pumps have a capacity each of 750 gallons a minute, 30 fire alarm boxes are distributed about the grounds, and there are over 100 fire hydrants

The Triumphal Bridge by Day.

connected either to this system or to the city water system. In addition, all the important buildings have stand pipes with reels of hose. There are also three steam fire engines located on the grounds.

In the inner court of the machinery building, in the basement, is an exhibition power plant with steam engines aggregating 2,100 horse-power and gas engines aggregating 900 horse-power. Steam is supplied by a boiler plant in a separate building west of the machinery building. Natural gas is used for fuel. The units in this plant are mostly for driving 12 Roots rotary pumps with a joint capacity of 35,000 gallons a minute, although several engines are direct-connected to generators and furnish power to different parts of the building.

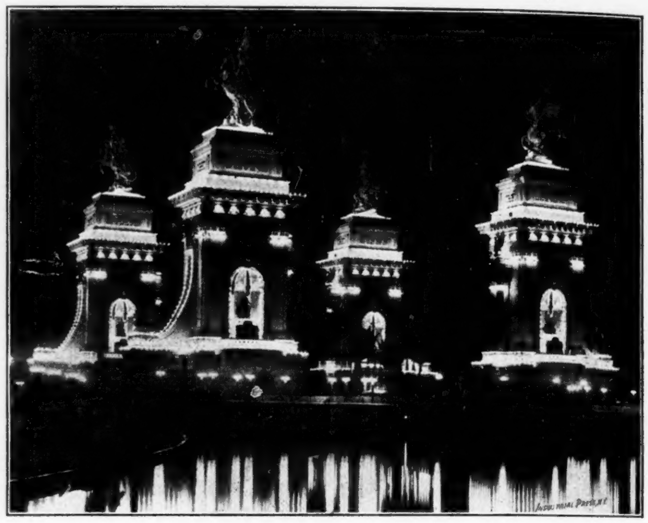
Machinery and Transportation Building Illuminated at Night.

The Roots pumps are for supplying the fountains and the cascade that pours from the side of the Electric Tower at a height of 60 feet. The exhibits in this department were at first so covered by a low roof as to be both invisible and inaccessible. This has since been changed by raising the roof several feet, although one might miss them unless he were acquainted with their location. The engine exhibits have even less of novelty than the machine tools exhibits, with the exception of the gas engines. The units are small, but on the whole fairly represent the various types of engines in use in America to-day.

The gas engines in the power court range from 100 horse-power to 275 horse-power. These are exhibited by the Alberger Co., Buffalo; the Bessemer Gas Engine Co., Grove City, Pa.; the National Meter Co., New York; Struthers, Wells & Co., Warren, Pa., and the Marinette Iron Works, Marinette, Wis. The steam engines are exhibited by the American Engine Co., Bound Brook, N. J.; Murray Iron Works, Burlington, Ia.; Lane & Bodley, Cincinnati; Ames Iron Works, Oswego, N. Y.; Harrisburg Foundry and Machine Co., Harrisburg, Pa.; Fitchburg Steam Engine Co., Fitchburg, Mass.; Watertown Engine Co., Watertown, N. Y.; Straight Line Engine Co., Syracuse, N. Y.; Skinner Engine Co., Erie, Pa.; Ball Engine Co., Erie, Pa.

Electricity Building.

The largest exhibits in the Electricity Building are by the General Electric and the Westinghouse companies. The transformer plant is a part of the exhibit of the former, and they



The Triumphal Bridge by Night.

also show a mining locomotive, an electric hoisting engine and a series of historical machines illustrating the development of the dynamo, besides their regular apparatus. The Westinghouse Co. have an imposing display in the center of the building, including generators and motors and a large Westinghouse gas engine. The Edison Manufacturing Co. exhibit a large number of the Edison Laboratory products. The Bullock Electric Mfg. Co., Cincinnati, exhibit some of their handsomely finished motors and generators and the Crocker Wheeler Co. and other leading firms have similar exhibits. The carbon exhibits are unusually interesting. The New Nernst lamp is shown here for the first time and is used in lighting the building. The Bell Telephone Co. are represented and there is a collective exhibit of small electric devices and appliances. The number of exhibitors is between 60 and 70.

Railway Exhibits.

There are representative railway exhibits in the terminal railway station at the north end of the grounds. The Baldwin Locomotive Works show three locomotives, one of which is a Vauclain compound and one is fitted with a Vanderbilt firebox and tender. The firebox is of the cylindrical corrugated marine type and the tender has a cylindrical tank for water and the coal is carried at the forward end, the bottom of the pocket being inclined, which makes the coal easily accessible, whether a large or small supply is carried. The Richmond Locomotive Works show a compound and a full sized section of the cylinders, and valves, including the intercepting valve, of one of their compounds. There are four locomotives built by the Schenectady Locomotive Works showing standard types built by them for the New York Central, the Lackawanna and the Michigan Central railroads. The Brooks Locomotive Works also exhibit four locomotives, one, a fast passenger locomotive as used on the Lake Shore & Michigan Southern, one a Chatauqua type and two consolidations. The Pressed Steel Car Co. have a large and striking exhibit of cars and photographs. Several railroads are represented in one way or another, the New York Central showing the famous De

Witt Clinton and its train of three coaches. Various railway appliances are shown, and the air brake companies have large exhibits. One of the Baldwin locomotives is jacked up and operated by compressed air supplied by two Pedrick and Ayer Co.'s compressors.

Mining Building.

One of the most complete and entertaining exhibits is that in the Mining Building, and although mining and metallurgy are not associated with mechanical engineering except in that the latter is dependent upon coal and metals, the mining exhibits are well worth extended mention. They are notable in the first place from the fact that they were all on the grounds and in place two days before the opening of the exposition. A conception of what this has meant can be had from the fact that several of the largest exhibits, aggregating many tons came from the lake regions and from Alaska, and as arrangements for them were not made until last winter the specimens had to be gathered while the ground was covered with ice and snow. All of the principal ore-bearing States are represented with carefully arranged and labeled specimens, but the most space is devoted to those bordering on the Great Lakes. A series of mural paintings is calculated to show the possibilities of the mines, the shipping facilities and iron-working establishments bordering on the lakes, and particularly of the facilities at Buffalo. Among the instructive features are the mining statistics exhibited by charts on which are graphically portrayed some of the main facts regarding the production of coal and minerals in the leading countries of the world. One of these has in one corner a small scale drawing of the Eiffel tower, which is 1,000 feet high. Beside it is a representation of a column of coal, drawn to the same scale, which is supposed to be 1,000 feet square and 12 miles high. This represents the coal production of the United States in 1899. That of Great Britain is nearly as great, that of Germany two-thirds as great, and of all other countries combined about the same as that of Germany. The charts relating to the metals and to petroleum are scarcely less striking. At the center of the Mining Building are the ores and gems that are considered of the greatest value, and a person paying but a brief visit to the building should devote his attention to this section first.

Ordnance Exhibits.

A plan is carried out of an ordnance collection in which only private exhibits are shown. There are two buildings for this located in the southeastern corner of the grounds, directly adjoining the park. The buildings are steel structures and are themselves exhibits by the American Bridge Co., structural steel being classified under the engineering division of ordnance. At the center of one of the buildings is to be a model of the Attabara bridge, built by the Pencoyd Bridge Co. for General Kitchener during his operations in the Soudan. An interesting exhibit of shells is shown by the Firth Sterling Steel Works, Pittsburg, Pa. Here side by side are shells that have pierced several inches of armor plate and new shells that have not been used, and it is difficult to distinguish between them, except in the case of those that were fired before the soft cap came into use. The shells now in use have a soft steel cap containing graphite and vaseline performing the duties of a lubricant. There are displays of firearms by several leading makers of firearms, the Lidgerwood Mfg. Co., New York, show ammunition hoists, and the American Ship Windlass Co., Providence, R. I., windlasses. Considerable space is taken by commissary supplies. The Bethlehem Steel Co. show an immense piece of armor plate steel, which, however, is to be used for protection against burglars instead of projectiles. It is intended for a bank vault and contains a circular opening in which a door is to be fitted with a ground joint.

Between the two ordnance buildings is a full-sized model of a Bruzon coast defense turret, showing a section of the turret, with the gun, ammunition hoists, etc., in place and protected by an embankment, as would actually be the case. In connection with the government exhibits are also several pieces of heavy ordnance, the real articles in this case, including a disappearing coast defense gun, operated electrically.

THE MACHINERY BUILDING.

BRIEF MENTION OF THE EXHIBITS WITH SPECIAL REFERENCE TO THE SHOP TOOLS AND APPLIANCES.

The center of attraction at the Pan-American Exposition for those interested in mechanics and machinery is the Machinery and Transportation Building. The term transportation, however, is somewhat of a misnomer, since exhibits relating to railways are placed in the terminal station at the north end of the grounds and the transportation exhibits in the Machinery Building are mainly in the line of bicycles and automobiles. These occupy a large share of the space in the north side of the building, while the south side is occupied almost entirely with machine tools. The two ends also are occupied largely with machine tools and machinery of a heavy character. There is a tendency among the exhibitors of machine tools to show as many machines in operation as possible, many of them being engaged in actual work. Many are electrically driven with independent motors. To facilitate the operation of the tools there is an overhead framework of steel beams extending down the entire side of the building, for the support of countershafts.

In what follows no attempt has been made to give a detailed account of the exhibits, but brief mention is made of what impressed the writer with the intention merely of giving a general idea, to one who is about to visit the exposition, of what is to be seen in this department. Only such appliances are mentioned as are most closely connected with the requirements of the machine shop. We hope in a later number to give a more detailed and complete account of certain new machines that are only briefly alluded to in the present number.

Machine Tool Exhibits.

The American Tool Works Company, Cincinnati, Ohio, show several standard machines, two of which, their 5-foot and 2½-foot radial drills, are of new design, with back gears on the spindle and tapping attachment. The small drill has a swivel table. They show a 16-inch back-geared crank shaper which is also new, and a 26-inch triple geared shaper. There are three lathes, and a motor-driven planer, with the motor placed on the uprights overhead.

The Belmer Eames Tool Company, Cincinnati, Ohio, have a planer exhibit. Their machines are massive, modern in appearance and design and receive favorable comments.

The Bradford Machine Tool Co., Cincinnati, Ohio, have an exhibit of lathes, one of which is a 21-inch engine lathe with a new arrangement for taking up the slack in the feed belt. They show an engine lathe with a turret attachment on the carriage, equipped with a set of tools for boring; one of these tools is a four-lip drill with straight flutes. The blades of this drill are not backed off, the cutting being entirely on the ends of the blades. This tool is said to give excellent satisfaction when truing up bored holes.

As usual, at such expositions the Brown & Sharpe Manufacturing Company, Providence, have an attractive display of their machine tools and of their small tools for machinists' use. There are two automatic gear-cutting machines, and one automatic screw machine in actual operation; and the other tools shown are a plain grinder, a universal grinder, a surface grinder, a cutter and reamer grinder, two universal milling machines and two plain milling machines. A vertical milling machine of new design is shown, which is a marked departure from the pattern that has been their standard for many years. This machine is of small size and has several novel features that we shall call attention to in a later number. These relate to the method of driving the spindle, the arrangement of the feed motion, and the quick return to the spindle. A new gear model is also shown, designed primarily to show the degree of accuracy that can be obtained in cutting bevel gears with rotary cutters. The model has a train of bevel gears connected with one end of a shaft, to the other end of which is a train of spur gears, both trains driven from the same source. In the bevel gear train is a differential motion which indicates a very slow movement on a dial that moves a pointer very slowly over a dial; and as this differential motion is the result of both the spur gear and the bevel gear trains, any difference in the spacing of the teeth of the two can be detected

by noting the change of motion on the dial. Among their small tools is a surface gage consisting of a standard which supports an American Watch Tool Co.'s indicator and makes a very delicate instrument. They also have one of their metric measuring machines on exhibition.

The Bullard Machine Tool Company, Bridgeport, Conn., are in a prominent location at the east end of the building, and have their tools set up for actual machine shop operations. There are four boring mills, and two turret lathes exhibited. All of the boring mills are of recent design, and their 37-inch mill, the smallest one shown, has several new features, connected with the driving and feed arrangements. There is a large gear reduction giving a high belt speed. The 42 inch mill has a long boring bar with a vertical rack and pinion adjustment entirely independent of the vertical adjustment of the head. Thus, when starting to bore a piece, the bar can be raised or lowered until the tool is in the desired position, without moving the head or throwing out the friction clutch connecting the head with the feed mechanism. This mill is also fitted with a turret, and one of the heads is offset so that it can be brought to the center of the mill for boring without interfering with the other head, which can be used for facing near the center at the same time. Three of the sizes of mills shown are designed for screw cutting.

The machines exhibited by the Becker-Brainard Milling Machine Company, Hyde Park, Mass., are already familiar to our readers as they have been illustrated in our columns from time to time. A No. 5B vertical machine is set up, prepared to do actual work. One of their new horizontal machines is shown, which has the features of a long saddle for the support of the table, an unusually long cross feed and a vertical milling attachment for heavy work. There is a universal machine on exhibition and a new cutter grinder adapted not only for the usual style of cutters, but for large face mills with inserted teeth and end mills of any style, such as, for example, roundnose mills which can be formed accurately to the desired radius.

The Cleveland Machine Screw Company, Cleveland, Ohio, have a group of their machines in operation, which illustrate the remarkable extent to which automatic machines have been developed during the past few years. Several of their machines are new and are shown here for the first time. One of these is an 18-inch automatic chucking machine for operating on work of any size up to 18 by 18 inches. It is designed for castings and forgings which are held in a chuck, and there are five spindles for holding the boring tools, each spindle coming automatically into position in turn and feeding toward the work. A cross slide is provided for turning the outside of pieces simultaneously with the boring. Several other sizes of smaller automatic machines are shown, ranging from a ⅜-inch to a 2¾-inch automatic machine. The largest machine can be used with an oil tube drill and has a slow spindle speed for thread cutting or heavy milling. A 2-inch machine is equipped with a magazine attachment and has an inside forming tool of new design. The smallest machine is turning out a complicated piece by the aid of a forming tool and an independent cut-off and centering tool. There is also a side-drilling attachment for drilling at right angles to the axis of the work. The various attachments provided with these machines and the wide range of work that the group of machines exhibited is capable of turning out make the exhibit of unusual interest. An automatic worm milling machine is in constant operation and attracts much attention. This machine has already been illustrated in our columns.

The Detrick & Harvey Machine Company, Baltimore, Md., show an open side planer, motor-driven, a horizontal milling, drilling and boring machine and a bolt cutter and a nut facer. The latter is designed for facing nuts by the use of a formed cutter which chamfers the outside edge at the same time and also slightly chamfers the edge of the threaded portion. The horizontal boring, milling and drilling machine has a traveling head and bar supported by a vertical column, and the work is clamped to a universal table where it can be operated upon at any angle.

Walter H. Foster, New York, has a space where are shown exhibits by the Potter & Johnston Company, Pawtucket, R. I.; the Landis Tool Company, Waynesboro, Pa.; the Gisholt Machine Company Madison, Wis.; and the Morton Manufacturing Company, Muskegon Heights, Mich. Potter & Johnston have their simplex automatic chucking, boring and turning machine and two sizes of shapers electrically driven. The automatic machine is designed for finishing castings and forgings entirely automatically, including boring, turning and facing. One man can operate four of these machines. An illustration of the machine has already appeared in the advertising columns of MACHINERY, and its appearance is doubtless familiar to our readers. The Landis Tool Company have a universal grinding machine of 12-inch swing and a plain grinding machine with a capacity of 72 inches between centers, the latter having recently been placed on the market. It is a new type of machine adapted for grinding shafts, spindles and other work up to the capacity of the machine. The Gisholt Machine Company have one of their tool grinders, and a turret lathe. The latter has a new feature, in that the carriage can be moved rapidly to and from the work by power through the operation of a lever, and the lathe is electrically driven. The Morton Manufacturing Company exhibit a draw cut shaper and a key-seater.

The Faneuil Watch Tool Company, Boston, Mass., show a large line of finely finished Rivett bench and precision lathes of their manufacture. These lathes are equipped with milling and other attachments, adapting them to a wide range of work. The Rivett-Dock threading tool already illustrated by us, is shown in several sizes and a new cutter grinder is exhibited.

The Fox Machine Company, Grand Rapids, Mich., devote considerable space to a display of their universal wood trimmers for patternmakers' and other woodworkers' use. There are several sizes of these, ranging from the small bench machine to the large 8F machine on a pedestal, which is said to be the largest of this type that is made. They also exhibit the Fox single and multiple spindle high speed drills, which have three changes of speed for each spindle independently. Miter machines on the plan of their wood trimmers are shown, these machines having a double knife which slides vertically. One of the newer products of this company is an improved typewriter of standard design, which is one of the most handsomely finished machines made. Several of these machines are shown.

The G. A. Gray Company, Cincinnati, have two planers in operation, one a 36-inch by 8-foot planer, with spur gear drive and with the motor mounted on the uprights. The other, a 30-inch planer, has the spiral drive with the motor on the floor. A feature recently adopted by this company is an adjustable belt shifter. The fingers that drive the belts, as they are shifted for the reversal of the planer table, can be adjusted so that the belts can lead from the planer to the countershaft at any reasonable angle desired. To demonstrate their smooth reversal these planers are running with glasses filled with water setting on the tables.

The Merrell Manufacturing Company, Toledo, Ohio, have an interesting pipe threading machine. Among its features are a quick opening and closing die; a thread gage, enabling one to cut from two to any number of threads automatically; a quick pipe grip; an automatic oiling device which goes into operation when the machine begins to thread the pipe; and it will cut short nipples, a self-centering device being provided for holding them. This company have only a small exhibit, since their representatives, Fairbanks & Co., have a store at Buffalo with a full line of their tools.

The Pratt & Whitney Company, Hartford, Conn., have fourteen machines that can be shown in operation. Several of these are automatic screw machines. One of these is fitted with a magazine, and is equipped for making typewriter buttons. Another is making hexagon bolts. One screw machine is fitted for making pet cock keys and has a capacity for turning out 1,000 per day. Their new type 14-inch lathe, previously shown in these columns, is exhibited. Other tools are a No. 3½ milling machine, a die-sinking machine, a pillar shaper, a two spindle profiling machine and a cutter grinder. A 16-inch chasing lathe is also shown, designed to do the work of the ordinary Fox lathe. It has a double revolving tool post and a turret, and the carriage has a quick return to facilitate rapid thread cutting. A multiple drill is shown,

and also two or three other machines not in operation. They display a large line of cutters, reamers and small tools, such as dies, etc., and have one of their measuring machines on exhibition. They show samples of long hole drilling, of which they have made a specialty, and one of the novelties is a model of the cannon, Long Cecil, made in Kimberly. This model is one of twenty-four furnished to the De Beers Consolidated Mines Company, South Africa.

The Prentice Bros. Company, Worcester, Mass., show several machines representative of the large line of upright and radial drills that they manufacture. They also exhibit a 24-inch engine lathe, which is one of the most novel and interesting tools to be seen among the machine tool exhibits. The motor is mounted beneath the lathe bed and is of constant speed, the motion being transmitted to the spindle through gearing. Changes of spindle speed are mechanical by the operation of levers and the lathe can be started, stopped or reversed and at an accelerated speed entirely independent of the speed of the motor. The reversal is so accurate that screws can be cut to the shoulder without stopping the lathe. The method adopted for driving their drills electrically was referred to in the description of their electrically-driven radial drill that appeared in June MACHINERY. A full universal radial drill is exhibited, in which the head is located at the head of the arm, and the arm itself is moved to and from the column when locating the drill.

The largest exhibit in the machine tool department is that of the Prentiss Tool & Supply Company, New York City. This company have a Buffalo branch in charge of Robert L. Crane, to whose efforts are due the arrangement of the attractive exhibit in which representative tools of numerous well-known builders are shown. The firms represented are the Cincinnati Milling Machine Co., the Bickford Drill & Tool Company, Cincinnati; the Lodge & Shipley Machine Tool Company, Cincinnati; the Cincinnati Planer Company, the Cincinnati Machine Tool Company, Fay & Scott, Dexter, Me.; Rogers & Hemphill, Alfred, N. Y.; the B. F. Barnes Company, Rockford, Ill.; the Acme Machine Screw Company, Hartford, Conn.; and the Cataract Tool & Optical Company, Buffalo, N. Y. The Cincinnati Milling Machine Company exhibit four milling machines, a cutter and reamer grinder and one of the most extensive collections of milling machine attachments that we have seen. The milling machines are of new design, heavier than the older type, and with various improvements, including an entirely new feed arrangement by which a wide range of feeds can be obtained through shifting levers at the back of the column. Among the milling machine attachments is a pair of index centers, designed to take the place of the usual indexing head and to save the wear of the latter when milling gears and other heavy work. One of the high-speed vertical milling attachments is provided also with a high-speed horizontal spindle that can be swiveled to any angle and used for spiral milling. Another new attachment is for vertical milling, but is much heavier than any that this company has previously made.

The tools shown by the Bickford Company include a full universal radial drill, motor-driven, with back gears on the spindle and a new arrangement for tapping. This drill is of new design, the motor is mounted on top of the column and forms a part of the machine proper. They show their new four-spindle, semi-automatic gear cutter that can be used for either bevel or spur gears, and is designed for manufacturers who have gears to make in quantity. They also exhibit a four-spindle multiple drill and a No. 0 radial, the latter of about the same capacity as an upright drill of medium size.

The tools shown by the Lodge & Shipley Company are a 24-inch lathe, an 18-inch lathe with taper attachment, and a 36-inch triple geared lathe. These are all of their standard design and have their special feed arrangement. The taper attachment shown is carried by the carriage of the lathe and requires no slide on the bed. The Cincinnati Planer Company have one planer on exhibition and the Cincinnati Machine Tool Company have several upright drills provided with their new tapping attachment, so arranged that the direction of rotation of the spindle can be changed through shifting a clutch operated by a hand lever. Fay & Scott exhibit a universal turret lathe with turret attachment on the carriage, this being one of their regular styles of lathes. Rogers & Hemphill have two boring mills, one of 45-inch swing with two heads, and the other of 31-inch, with a swiveled head and a turret for chucking, etc. These mills have the modern arrangement of feed gears grouped together in nests and are arranged for screw cutting. There is a B. F. Barnes tool grinder in which the water is raised to the wheel by raising a water tank. Instead, however, of having to raise the tank by a treadle or a lever, there are projecting arms at the front which, in appearance and operation, are similar to the arms of a turnstile; and a workman who wishes to grind a tool presses against one of these arms with his body, which pushes down the plunger and raises the water. There are two Acme automatic screw machines, five bench lathes exhibited by the Cataract Tool & Optical Company, and in addition to the machines above enumerated, manufactured by different firms, the Prentiss Tool & Supply Company show two of their own shapers. These have been remodeled and are of new design. One is a lever crank shaper back-geared, and the other a friction shaper with extension base and table support. In arranging the display of tools an effort was made to follow the lines of the modern shop as closely as possible. The hangers for the shafting, for example, are supported by three lines of parallel I-beams, to which are attached cast-iron brackets that can be adjusted longitudinally on the I-beams, and which are slotted to allow lateral adjustment of the hangers.

Warner & Swasey, Cleveland, Ohio, have one of their hollow hexagon turret lathes on exhibition, and also several new machines that are here exhibited for the first time. One of these is an improved 30-inch vertical turret chucking machine, in which the horizontal table is driven through spur gearing instead of through the usual bevel gears. There is a novel feed arrangement by which eight changes of feed are obtained either vertically or horizontally, and the feeds can be reversed or thrown in and out by the action of a lever. A change from vertical to cross feed can also be made by a lever and automatic stops are provided in both directions. The table has three jaws that are operated universally and three independent jaws. A plain manufacturing milling machine is shown designed to do the work of the Lincoln miller. Warner & Swasey also have an astronomical exhibit in the Liberal Arts Building.

The only exhibitors of large machine tools are the Niles Bement Pond Company, New York, who show a few machines made by each of the firms forming this company. The Pond Company have a 60-inch planer and a 60-inch lathe. The Bement Company a 5,000 pound steam hammer and a large vertical milling machine, and the Niles Company a 7-foot boring mill and a large radial drill with a motor on top of the column.

Near this exhibit is a display of steam hammers by the Bell Steam Engine Works, Buffalo; and the Long & Allstatter Company, Hamilton, Ohio, show several heavy machines for operating on plate metal. One of these is for punching forty 5-16-inch holes in a plate at one time. There is also a double angle shear, a regular 1-inch punch and a horizontal punch and bender.

The Whitney Manufacturing Company, Hartford, Conn., show their new manufacturers' hand milling machines, recently illustrated in these columns. They also exhibit a centering mechine and a case of goods, among which are examples of their well-known system of keys and chains.

Small Tools.

In addition to the machinists' tools exhibited by the Brown & Sharpe Manufacturing Company, and the Pratt & Whitney Company, previously mentioned, there are several exhibits of small tools by different firms. The Morse Twist Drill & Machine Company, New Bedford, Mass., have three cases filled with their well-known line of drills, reamers, cutters, etc. The drills are shown in great variety from 4½ inches in diameter to small sizes, and there are a number of oil drills, one style of which is made by first drilling the holes through the stock from which the drill is to be made, then twisting the stock and finally fluting it. Several complicated formed cutters are shown.

The Cleveland Twist Drill Company have an exhibit attractively arranged in an elaborate case that was used for their Paris exhibit. They show a complete line of drills, reamers and cutters, and have a new design of drill socket with the slot in which the taper key is driven when removing a drill, tapering in both directions from the center, so that the key can be driven from either side and will also have an even bearing on the end of the drill.

The Standard Tool Company, Cleveland, have special arrangements for illuminating the tools in their cases, which shows them to good advantage. Their smallest drill is .005 inch in diameter, their largest 4½ inches. They show some unusually long oil tube drills and exhibit a feed drill with an inserted cutter designed for boring long holes. They also have a new drill socket which will receive or release the drill by a half-turn of a knurled collar. The drill is held by a finger bearing in a slot in the shank of the drill.

L. S. Starrett Company, Athol, Mass., have their usual extensive display of tools for machinists' use. This includes all of their regular line, many different sizes of different styles being shown. Certain new tools exhibited are already familiar to our readers, and the display is one that will prove quite as attractive to the mechanic as any in the building.

Power Transmission.

In the line of power transmission machinery there are several exhibitors. The Dodge Manufacturing Company, Mishawaka, Ind., show split pulleys and apparatus to demonstrate the features of their well-known system of power rope transmission. The sign placed over their exhibit is lighted by electricity and has a unique arrangement of ropes and pulleys which calls attention to their power transmission devices.

The Reeves Pulley Company, Columbus, Ind., exhibit one of their large variable-speed, power transmitting devices, such as has recently been illustrated in the advertising columns of this paper. The Oneida Steel Pulley Company have an interesting exhibit, and other exhibitors of pulleys are the South Bend Pulley Company, South Bend, Ind.; the American Pulley Company, Philadelphia; and the Fulton Pulley Company, Fulton, N. Y. The Diamond Drill & Machine Company, Birdsboro, Pa., show their method of belt lacing with the machine used for lacing the belt. There are several exhibitors of leather belting.

Under this heading reference should be made to the exhibit of the Cling-Surface Manufacturing Company, Buffalo, N. Y., who have one of the most unique exhibits in the building. It consists of two dynamos, one driven by an ordinary belt and the other by a belt treated with Cling-Surface. Each dynamo operates a bank of electric lights. There is a means of adjusting the tensions of the two belts so that they may be brought to exactly the same point, and the superior brilliancy of the bank of lights, operated by the Cling-Surface belt, is very marked.

Power Presses.

The feature of the exhibit of the E. W. Bliss Company, manufacturers of power presses, Brooklyn, N. Y., is a set of machinery in actual operation for the manufacture of tin cans. The style being produced is a small can with a screw top, such as is used for polishing liquids, varnish, etc. The body of the can is made with flat sheets of tin by an automatic machine which bends the tin and forms a lock seam at the rate of 75 a minute. The top is stamped out and formed by a five-slide press which is said to do the work of fifteen single presses, each of which would require an operator. The other machines for completing the can are, an automatic crimper for turning and crimping the edges of the tops and bottoms of the cans, and a machine for rolling the threads on the cap and the top that screws onto the cap. After this top has been pressed into shape and the cap has been formed to receive it, the top is placed on the cap and the thread rolled on both simultaneously, one of the rollers operating on the inside and the other on the outside; and provision is made for enough clearance between the two parts so that the top can be easily unscrewed with one's fingers. In producing these cans the labor cost has been so reduced that the value of the tin is several times greater than the cost of the labor.

The Ferracute Machine Company, Bridgeton, N. J., have a large exhibit of power presses, punches and coining machinery. The exhibit is situated at the east end of the building, near that of the E. W. Bliss Company. Twelve presses are shown in all, among them a special press for punching armature disks, which has an indexing arrangement that is one of the new features to which they call attention. The indexing is through an accurately cut spur gear and a ratchet wheel with change gears connecting with the index gears. By the use of two ratchets, one with odd and one with even teeth, and a set of change gears, any number likely to be desired can be obtained. A heavy press for cutting armature disks at one stroke has a new attachment in the way of a friction clutch, the feature of which is that it can be set so that when thrown in the press will either run continuously or stop automatically at the upper end of each stroke. The other presses are of various sizes and are of their standard designs. An improvement noted in their coining press, two examples of which we have already illustrated, is placing the toggle movement underneath instead of above the ram. The most interesting feature of their exhibit is the display of a large number of stampings and intricate pieces that have been produced on the Ferracute presses. The presses are all belted from below, avoiding overhead countershafts and belts, which adds to the appearance of this exhibit.

Grinding Machinery.

The Builders Iron Foundry, Providence, R. I., have an exhibit at the west end of the building and show their grinding machinery, their "Pull" countershafts, and the registering apparatus that they manufacture for the Venturi water meter. They also exhibit a number of photographs showing the construction of coast defence guns at their works.

The Diamond Machine Company, Providence, R. I., show representative samples of their large lines of grinding and polishing machinery.

L. S. Heald, Barre, Mass., has an exhibit of twist drill grinders, the standard type of which has been illustrated in these columns. A new type recently brought out is a wet grinder so arranged that a large quantity of water can be used, as the hood is of ample capacity to protect the operator. He also shows the new center grinder illustrated in the June number.

The Norton Emery Wheel Company and the Norton Grinding Company, Worcester, Mass., have a large exhibit in an attractive booth at the main entrance of the Machinery Building. In addition to the line of emery wheels shown, representative of the products of the Norton Emery Wheel Company, there are a great many samples of work that illustrate the capacity of the Norton grinding machine. These samples are entirely similar to those illustrated in the June number of MACHINERY, and thus it will not be necessary to refer in detail to their exhibit.

The Washburn Shops, Worcester, Mass., exhibit a large line of twist drill grinders, there being in all twenty machines, and ten varieties of grinders. The latest of these is the wet grinder with a new method of supporting the drill, the point of the drill being inclined downward toward the wheel and the drill holder being supported from a point at the rear of the wheel. This grinder was not on exhibition at the time of our visit. A machine for handling unusually long drills is shown. There is also a 14-inch lathe which, while having no special features, is of interest in that the students of the Worcester Polytechnic Institute, with which the Washburn shops are connected, made many of the patterns from which this line of lathes is to be built.

The Wilmarth & Morman Company, Grand Rapids, Mich., manufacturers of the Yankee twist drill grinder, have an exhibit. The feature of this grinder is that a drill of any size, automatically adjusts itself to the correct position without making any change in the adjustment of the machine.

The mention of grinding machinery and abrasive materials would not be complete without calling attention to the exhibit of the Carborundum Company, Niagara Falls, N. Y., the products of whose plant are due to the development of the water power at that place. Carborundum is a product produced electrically and is being used extensively as an abrasive material.

We understand that O. S. Walker & Co., Worcester, Mass., are to show a new electrically driven surface grinder, but no exhibit of this firm was in place at the time of the writer's visit.

Miscellaneous.

The Chisholm & Moore Manufacturing Company, Cleveland, Ohio, have a large exhibit of their pneumatic and hand power cranes, trolleys and hoisting apparatus, the latter including both the pneumatic and main hoists. Their pneumatic motors are also shown.

Among the miscellaneous exhibits that will be of interest to MACHINERY readers are those of the E. Horton & Son Co., Windsor Locks, Conn.; the Hoggson & Pettis Manufacturing Company, New Haven, Conn.; the Oneida National Chuck Company, Oneida, N. Y., all of whom exhibit chucks. The National Tool Works, Pittsburg, Pa., and the Shelby Steel Tool Company, Cleveland, have large exhibits of tubes, some of them being very heavy and of large dimensions.

The Buffalo Forge Company, Buffalo, N. Y., have one of the most conspicuous displays, consisting of a pyramid of blowers, starting at the base with the largest size (used for heating and ventilation) and ending with a very small one at the top. These blowers are in operation. The engines made by this company are also shown. The American Blower Company, Detroit, Mich., have an exhibit of blowers and of some of the special apparatus that they manufacture in connection with the blowers. J. B. & J. M. Cornell, New York, are also exhibitors.

The Henry R. Worthington Company, New York, have the largest exhibit of any pump manufacturer, the chief feature of which is a 45- by 18-inch jet condenser, bucket type of pump, operated electrically. It is the first of several for the new power station of the Manhattan Elevated Railway.

Among the woodworking machinery exhibits the most complete are those of the H. B. Smith Company, and of E. & C. Atkins & Co., Indianapolis, Ind., which latter company display circular saws, arranged on a large revolving column, that attracts much attention.

Of the gas and petroleum engine exhibits on the main floor of the Machinery Building are several sizes of the Otto engine, made by the Otto Gas Engine Company, Philadelphia, and also of the Mietz & Weiss kerosene engine, made by Mietz & Weiss, New York.

Jenkins Bros., New York, show a complete line of their well-known type of valves, which includes a large number of styles and sizes for both heavy and light service. This exhibit, in common with that of several others who make fittings or steam specialties, is very complete.

Among the other firms who show steam specialties may be mentioned the Lunkenheimer Company, Cincinnati, who exhibit lubricators, injectors and other specialties. The American Steam Gage Company, Boston, show gages, indicators and other brass goods or specialties. There are several exhibitors of valves not previously mentioned; several exhibitors of roller and ball bearings; the Trimont Manufacturing Company, Roxbury, Mass., and the Atlas Pipe Wrench Company, New York, exhibit wrenches.

The Walworth Manufacturing Company, Boston, Mass., have a large and well arranged exhibit, giving a very comprehensive idea of their line of pipe fittings, wrenches, pipe cutting and threading tools, etc. It is one of the most complete displays of this kind that we have seen.

J. H. Williams & Co., Brooklyn, N. Y., exhibit their Vulcan chain pipe wrenches and samples showing the different sizes and styles of their drop forged wrenches, lathe dogs, eye bolts, and other specialties, among which are several new lines that have recently been added to their stock.

* * *

Eight bridge girders were recently shipped from Chicago, Ill., by the American Bridge Company for a bridge over the Grand River on the line of the C. B. & Q. R. R., which were of unusual size. Each girder was 105 feet long and 10 feet high, and weighed nearly 41 tons. The transportation of them was a rather difficult undertaking. Each girder was loaded on three flat cars, so it stood on edge, or its normal position. The weight was carried by the two end cars, the intermediate car acting merely as a buffer and to transmit the draft of the train.

LARGE MICROMETER CALIPERS.

J. B. THOMAS.

The illustrations, Figs. 1 and 2, are from a pair of photographs of large micrometer calipers which are a departure from the usual practice in the shaping of their frames. Large calipers of this kind are usually made with frames of the same general shape as those of the ordinary smaller calipers;

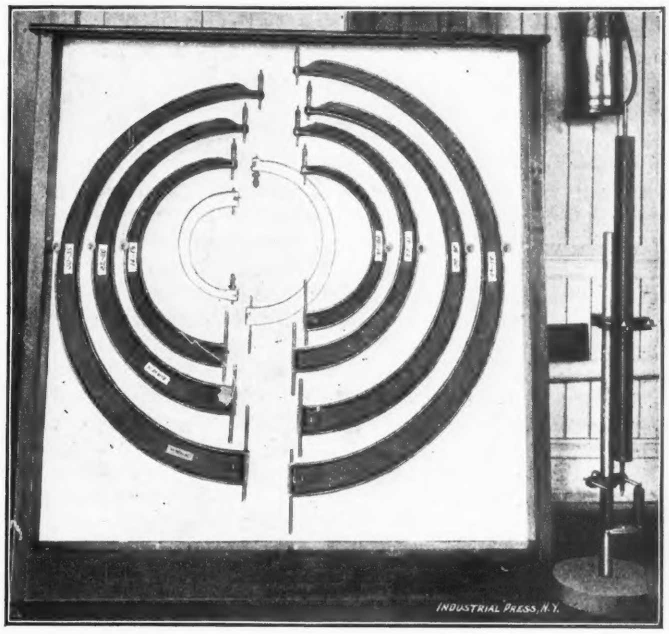


Fig. 1. Micrometer Case with Instruments to Measure from 10 to 14 inches.

that is, tapering from the middle toward each end. In these calipers the frames are wider at the bottom near the anvil, and taper gradually toward the top near the head, thus obviating greatly the deflection when supporting the tool at its base.

Fig. 2. Method of Setting a Pair of Large Calipers to the size of a Reference Rod.

The stand shown at the right of the micrometer case, in Fig. 1 is adapted for taking any kind of a rod or pin gage, that is, a naked or encased rod. A pair of springs adjustable either vertically or laterally with connecting bar, support the

weight of the caliper while setting to size, the thumb and finger of the left hand being used to center the anvil on the lower point while feeling for contact at the other end of the gage. A similar arrangement of springs, supported by a brass sash chain, is used to support the caliper when taking measurements of a large shaft, so that measurements of both gage and shaft are taken under exactly the same conditions.

In the micrometer case, shown in Fig. 1, are shown six sizes of large calipers, stepped up in size as follows: 14 to 18 inches, 18 to 22 inches 22 to 26 inches, 26 to 30 inches, 30 to 35 inches, and 35 to 40 inches. Their frames are made of an alloy of aluminum and small proportion of zinc.

* * *

THE LACASSE BALL BEARING.

During the past twenty years there have been developed many anti-friction bearings, all embodying the same essential principle, but applied in different ways with widely varying efficient results. The geometrical principles involved in a ball bearing have often been misunderstood or disregarded, with the consequence that many anti-friction bearings have been made which, while fairly efficient when new and under light loads, were not well adapted to prolonged and continuous use with heavy loads. Ball bearings are all of the two-point, three-point or four-point contact type. It can be demonstrated, however, that all ball bearings are modifications of the four-point

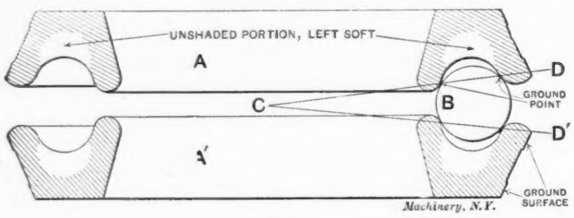


Fig. 1.

contact type, one or two points of contact in the others being combined in one without changing the essential principle of action. But while the principle of action may be the same, the practical results have not been so. The superiority of the four-point bearing has been recognized for a long time, but the difficulties of accurate construction have made it commercially unfeasible for most purposes. Five years of the manufacture of the Lacasse four-point bearing, shown in the two annexed cuts, were required to develop the proper machinery for its manufacture on a commercial scale.

This ball bearing has been developed on the interchangeable

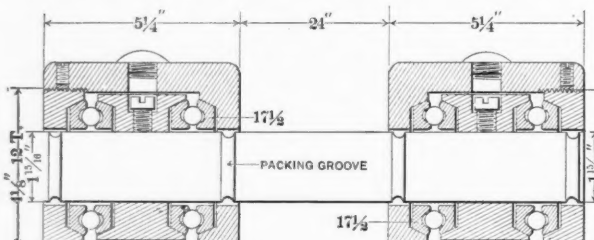


Fig. 2.

plan, not only as to the mere feature of interchangeability of the component parts of any one size of bearing, but the bearing itself is interchangeable for all conditions and sorts of uses. That is, it is, for instance, equally well adapted for supporting shafts in a horizontal position as for supporting end thrusts. The construction is the same in each instance. We are informed that the actual form of this bearing, as illustrated in Fig. 1, has been found to be a positive necessity in every particular. First it must be made of such quality of steel as will take the hardest temper and have the greatest possible strength. To obtain that strength the form of the present bearing was resorted to, every curve and surface composing it are essential to obtain the hardness of the steel at points of contact of the balls, as it will be noticed that the ball contacts are on two distinct points in the ball race. These points are so located that the balls roll on all points of contact and both ball races are of such accuracy as will admit of a positive rolling contact. This is accomplished by a specially designed emery grinder which acts on three points of the race at the same time, the outside angle and the two points on which the balls bear in the groove, so that all points ground are concentric, one with the other.

While the bearings are being operated on they are tested as to exactness with a specially designed micrometer caliper, and when they are removed from the machine they are strictly interchangeable within limits of .0001″. The outside angle, which was found to be necessary in order to produce the required temper in certain parts of the ball race, was therefore adopted as standard. It will be noticed that the ball race or cup does not seat on the bottom, but is seated on the angle instead, so that no great accuracy of the diameter is required in grinding or in seating the bearing provided the proper angle is obtained, as all ball bearings must have end adjustment, therefore a slight variation in the diameter is readily taken up by the end adjusting collars at either end of the boxes carrying them.

The geometrical principle involved is shown by Fig. 1. The cups, *A*, *A′*, are duplicates in every particular, and the position of the bearing points is such that lines *C D* and *C D′* drawn through the points of contact intersect at the center, thus reducing the ball in its essential action to a conical roller. Fig. 2 shows the application of this bearing to emery grinders, which is so easily understood that further explanation is unnecessary. These bearings are manufactured and sold by the Auburn Ball Bearing Company, Auburn, N. Y., and are recommended by them for all purposes where an anti-friction bearing is desirable.

* * *

In the shipping warehouses of the Fitchburg R. R., at Charlestown, Mass., there is an installation of elevators which facilitates the transfer of freight from floor to floor. The elevators are arranged to take packages of all kinds from the tracks on the ground floor to the second floor, for loading into vessels or storage; and to lower the freight received from vessels on second floor to first floor, for loading onto wagons or cars. The peculiarity of the elevators is that they are in the form of chain conveyors and run continuously. Each elevator consists of a double line of chains and between these two chains are suspended carrying trays 8 feet wide. These trays swing freely between the chains and always maintain a horizontal position. At each floor are automatic unloading devices consisting of fingers which intermesh with the carrying fingers of the trays, and which therefore, when interposed in the path of the trays, automatically remove the load, as the trays descend. Similar devices are provided at the floors for automatically loading the trays in their upward path.

* * *

The rapidly increasing industry of manufacturing steel cars has been the cause of a considerable variety of special machinery to cheapen the cost of production. As an example mention is made of a multiple punching machine recently installed in the plant of the American Steel Foundry Company, St. Louis, Mo., by the firm of Williams, White & Co., Moline, Ill., which will handle a plate 8 feet wide between the housings and 40 feet long on the automatic spacing table. There are 20 punches in a row at right angles to the axis of the table. Each punch is operated by an independent gag which may be pulled out and any punch thrown out of operation. In this manner a great variety of combinations of holes may be punched at one operation, all in the same lateral plane. The ram or head is reciprocated by a transverse shaft carrying three eccentrics on which are mounted eccentric straps with short connecting-rods pivoted to the ram. The weight of the punching machine complete is about 40 tons.

* * *

There ought to be a reason for every rule. Rules of thumb are allowable only when better rules cannot be obtained.

POWER TRANSMISSION BY BELTS.—1.

LARGE ANGLE OF WRAP VS. SMALL WRAP HIGH SPEED VS. LOW SPEED.

FORREST R. JONES.

There are in common use two radically different methods of making belt connections between a pair of shafts for the transmission of power between them. By one method a belt is run directly from a pulley on one shaft to its mating pulley on the other without the use of idle, guide or tightener pulleys, thus obtaining what are ordinarily spoken of as "straight stretches" of belt between the working pulleys. By the other method idle pulleys are introduced to increase the angle of wrap of the belt about the pulleys. One or more such idlers may be used, according to the nature of the drive, and, in any case, one of the idlers is used for a belt tightener. In the majority of belt drives with a large angle of wrap, that are in use in this country, the belt speed is higher than is commonly used with straight stretches of belt between the working pulleys. This is not so generally true where the belt runs from an engine, however, for the face speed of an engine pulley is often so high at the normal engine speed as to make it inadvisable to increase it for any purpose. There is no reason, of course, why the belt speed should be in any way affected by the angle of wrap; but it is more convenient to place large diameter pulleys when guide pulleys are used than when they are not, for the belt is more readily kept out of the way when idlers are used to guide it. Hence, for a given rate of rotation, a system with guide pulleys and large angles of wrap affords a more convenient means of securing high belt speed than straight stretches of belt between the driving and driven pulleys.

The advantage of a large angle of wrap and high speed, as compared with a small angle of wrap and low speed, is what the writer especially desires to point out. This may be conveniently arrived at by first showing the effect of increasing the belt speed without varying the angle, and then of increased angle of contact with constant belt speed. A definite case of a given amount of power to be transmitted between two shafts having the same speed of rotation, which remains unchanged, by different belt drives, will be used to illustrate perfectly practical cases.

The Losses at the Bearings of a Shaft.

A considerable part of the power loss in a belt transmission system is at the journal bearings supporting the parts. The pressure against the bearings is partly due to the belt tensions and partly to the weight of the parts supported by the bearings. If the belt tensions can be kept low, without increasing the weight of the parts supported by the bearings, there will be a reduction of the power lost at the bearings. This reduction is on account of the reduced pressure on the bearings. The belt tensions can be reduced by increasing the belt speed, within certain limits, in a system for transmitting a given amount of power. This increased belt speed can be secured by using larger pulleys without changing the rate of rotation per minute. The centrifugal action on the belt is the chief factor that limits the belt speed. There are exceptional cases where decreasing the belt tension by increasing its speed will not, at least to any great extent, decrease the pressure on the bearings.

Effect of Belt Pull in a Vertical Drive.

Take, for an illustration, a drive where a belt connects two pulleys of equal diameters on parallel shafts, one directly above the other. If the weight of the lower pulley and of the part of the shaft supported by the bearings is 200 pounds —which would, of course, cause a total of 200 pounds pressure on its bearings, if they are on opposite sides of the pulley—and the belt tensions are such that the belt just lifts the weight of the pulley and shaft, there may be no pressure on the bearings of the lower pulley. Now suppose that, by increasing the speed of the belt, its lifting action on the lower pulley is reduced to 150 pounds. If the weight of the lower pulley and its shaft remains 200 pounds as before, there will be a downward pressure of 50 pounds on the bearings instead of nothing, as before. At the same time, if the weight of the parts supported by the bearings of the upper pulley remains unchanged, there will be a reduction of the pressure on its bearings by 50 pounds on account of the reduced downward pull of the belt. On the whole, therefore, the total sum of the bearing pressures will be the same in both cases, and there will be no reduction of the power loss at the bearings.

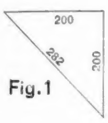


Fig.1

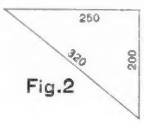


Fig.2

Fig.3

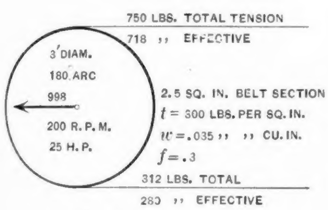


Fig.4

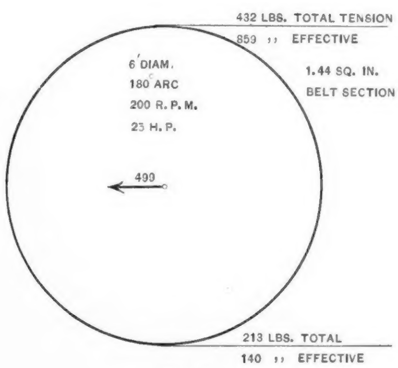


Fig.6

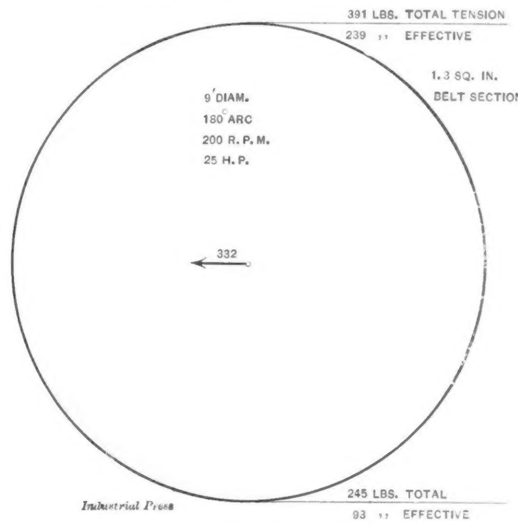


Fig.7

The case just cited is an exceptional one, because, in mechanical power transmission machinery, the sum of the tensions in the stretches of belt leading off vertically upward from a pulley, or nearly so, are almost invariably great enough to more than overcome the weights of the parts. Had this been the case in the example just given, the pressure against each bearing would have been reduced by 50 pounds. That is, the sum of the bearing pressures would have been reduced by twice the amount of reduction of the lifting action of the belt on one pulley. This is in accordance with the conditions that are generally found in practice. Or, again, had the lifting action of the belt been increased 50 pounds above the amount which just lifted the 200 pounds weight of the lower pulley, the pressures on each pair of bearings would also have been increased by 50 pounds. The shaft of the lower pulley would then be pressed upward against the top of its boxes.

Effect of Belt Pull with a Horizontal Belt.

In a drive where the stretches of belt are horizontal and connect pulleys upon two horizontal shafts lying at the same level, the belt pull and weights of the parts do not directly add together or subtract as above. The weights of the parts still act vertically but the pull of the belt acts horizontally, so that the two forces causing pressure upon the bearings act at right angles to each other. In accordance with this, if the pressure upon each pair of journals for a horizontal drive is 200 pounds and the belt pull is also 200

pounds, the resultant pressure due to these forces acting upon a pair of bearings supporting the pulley may be found graphically by drawing, as in Fig. 1, a horizontal line whose length, according to some convenient scale, is taken to represent 200 pounds. The scale may be taken as one inch of length for 200 pounds. This line may be taken to represent the belt pull. A second line, drawn vertically from one end of this and also one inch in length, may represent the 200 pounds pressure upon the bearings due to the weight of the parts. A line joining the extremities of the two just drawn and forming the hypothenuse of a right angled triangle will represent the resultant pressure against the bearings, both in amount and direction. By measurement, its length will be found 1.41 of an inch, which is equivalent to 282 pounds. This does not take into account the weight of the belt, half of the total weight of which would have to be added to the vertical force. The weight of the belt depends upon the distance between shafts as well as the cross-section of the belt. If the belt tensions are increased so as to make the horizontal force tending to pull the shaft against the bearings 250 pounds, the resultant pressure against the bearings will be 320 pounds, as shown in Fig. 2.

In the actual practice of transmitting power mechanically about shops and factories the weights of the parts are very much smaller in proportion to the belt pull than as just taken. As an example of this a pressed steel pulley 30 inches in diameter with an 8-inch face weighs about 74 pounds. If its shaft weighs 76 pounds, the total weight tending to cause pressure downward upon the bearings will be 74 + 76 = 150 pounds. The pull due to the tensions in the two stretches of belt running off from it will often be as great as a thousand pounds or more. Combining this horizontal force of 1,000 pounds with the vertical force of 150 pounds, as in Fig. 3, gives as a resultant pressure against the bearings 1,011 pounds. This is only a little more than one per cent greater than the sum of the tensions in the belt. The weight of the belt is here again neglected. Its effect would be correspondingly small except for unusually long stretches of heavy belt. In order to simplify the matter presented below, the weights of the pulley, shafting and belts will be omitted, now that the nature of their effect has been pointed out. The solution is thus left in such a condition that any weight of parts can be added on or accounted for.

Notation.

The calculations necessary for illustration will be made with aid of the following notation:

A = sectional area of belt, square inches;

N = revolutions of pulley per minute;

P = total turning force which must be exerted tangentially to the pulley face by the belt, pounds;

R = pressure of main shaft bearings against the shaft, pounds;

r = pressure of idler pulley bearings against its journals, pounds;

T_1 = total tension in tight side of belt, pounds;

T_2 = total tension in slack side of belt, pounds;

V = velocity of belt, feet per minute;

v = velocity of belt, feet per second;

p = turning force which a belt of 1 square inch sectional area would exert tangentially to the face of the pulley under the same conditions as those for the actual belt, pounds;

t = tension at which the belt is to work on the tight side, pounds per square inch;

w = weight of 1 cubic inch of belt, pounds;

a = angle of wrap of belt around pulley, degrees;

f = coefficient of friction between the surfaces of the belt and pulley;

π = 3.1416.

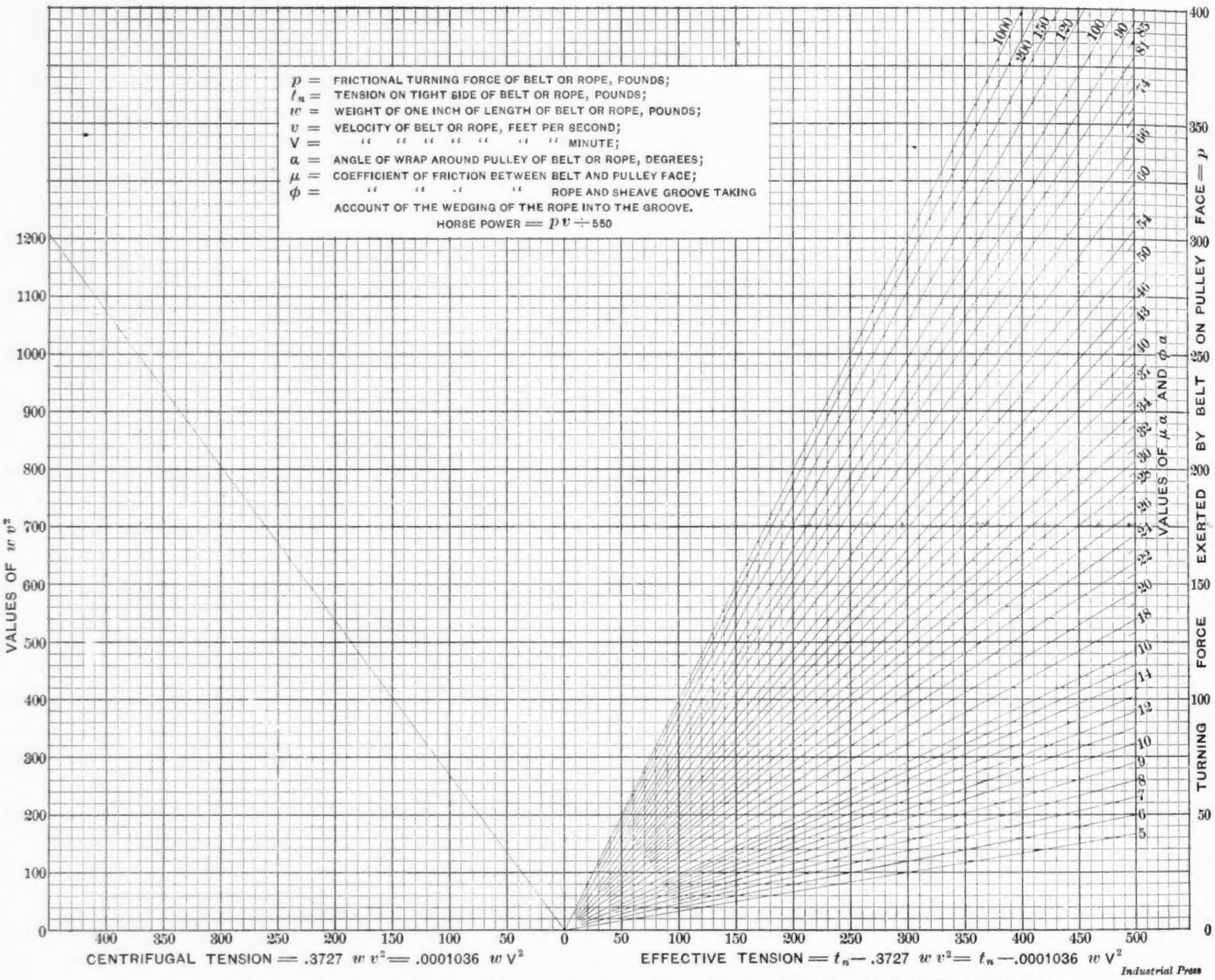


Fig. 5. Diagram showing the Relation between the Power Transmitted and the Tension in Belts and Ropes.

Calculations showing the Effects of Belt Tensions under Centrifugal Action.

In order to get at an understanding of the amount of pressure that is caused by the belt tensions against the journal bearings, and also the effect of centrifugal action, suppose

that the pressure against the two bearings supporting a pulley and its shaft is 200 pounds when there is no belt on the pulley, the bearings being on opposite sides of the pulley. If a belt is now placed on the pulley and wrapped half-way around it so that its two stretches are parallel and lead off vertically downward, the pressure against the bearings will be increased by an amount equal to the sum of the two belt tensions, $T_1 + T_2$, at the extremities of the arc of contact, plus the weight of the part of the belt wrapped on the pulley, *if the belt is standing still.* Thus, if the tension on one side is 400 pounds, and 600 pounds on the other, and the weight of the part of the belt on the pulley is 10 pounds, the total pressure is $200 + 400 + 600 + 10 = 1{,}210$ pounds *when the belt is at rest.* If the belt is now started to running, and the resistance to the turning of the pulley is kept such that the total tensions will still remain of the same values as before, the pressure on the bearings will become less than when the belt was at rest; because part of the tension is now due to centrifugal force on account of the speed and weight of the moving belt. The value of this centrifugal tension in each square inch of cross-section of the belt is obtained by the formula:

Centrifugal tension $= .3727wv^2$ pounds per square inch, in which $w =$ weight of one cubic inch of belt in pounds, and v is the velocity in feet per second. If the velocity is 80 feet per second, then

$$\text{Centrifugal tension} = .3727 \times .035 \times (80)^2$$
$$= 83 \text{ pounds per square inch of cross section.}$$

If the cross-section of the belt is 2 square inches, the total centrifugal tension in each stretch will be $2 \times 83 = 166$ pounds. This centrifugal tension has no effect toward drawing the belt against the pulley, and, consequently, causes no pressure on the journal bearings. The only part of the tension that is effective in turning the pulley is what remains after deducting the centrifugal tension from each of the total tensions T_1 and T_2. The values of the effective tensions are therefore:

$$600 - 166 = 434 \text{ and } 400 - 166 = 234 \text{ pounds.}$$

These effective tensions of 434 and 234 pounds are the ones which cause pressure against the bearings when the belt is running at 80 feet per second, instead of the total tensions of 600 and 400 pounds which caused bearing pressure when the belt was at rest.

The total pressure on all the bearings when the belt runs at 80 feet per second is therefore $200 + 434 + 234 + 10 = 878$ pounds. This is less than 73 per cent of the total bearing pressure of 1,210 pounds when the belt was at rest with the same total tensions in it.

Results with Thirty-six inch Pulleys.

It may now be assumed that twenty-five H. P. are to be transmitted between two shafts, one directly below the other, each to run at 200 revolutions per minute, and different belt drives designed for transmitting the power, and compared with each other. The first drive may be taken with a 36-inch pulley upon each shaft. Fig. 4 shows one pulley of a pair each 36 inches in diameter, with the stretches of belt running horizontally from it, the arc of contact being half a circumference upon each pulley. The velocity of the belt will be taken the same as that of the pulley. This is not strictly true, but to make allowance for thickness of belt and slippage, would cause unnecessary complication on account of using different diameters of pulleys—as will be done later—and would in no way affect the comparisons between different systems. Under this assumption the velocity of the belt is

$$V = N\,(\pi \times \text{diameter of pulley}).$$
$$= 200 \times 3.1416 \times 3 = 1885 \text{ feet per minute.}$$

or

$$v = 31.4 \text{ feet per second.}$$

The total tangential turning force required is

$$P = \frac{500 \times \text{horse powers}}{\text{velocity of belt, feet per second}}$$
$$= \frac{550 \times 25}{31.4} = 438 \text{ pounds.}$$

In order to make comparison between the different belt drives, the same kind of belting and coefficient of friction must be used in all systems. The following values will therefore be taken for each case: $t = 300$ pounds per square inch belt tension; $w = .035$ of a pound per cubic inch weight of belt; and $f = .3$ for the coefficient of friction. The calculations for these drives have been carried out more accurately than would be done in common practice. This is for the sake of making comparisons. In practice the width of belt would go by half inches instead of the small fractions of an inch given herein. The size of the belt and the total tensions in its two stretches may be found by first obtaining the turning force for a belt of one square inch sectional area, which at once gives a means for determining the size of belt for the required turning force. This can be conveniently done by the aid of the diagram Fig. 5, which, while not entirely eliminating numerical calculations, reduces them to two very simple ones. Following out this method, the product of the weight of a cubic inch of the belt, times its velocity squared, is necessary. This, for the case in hand, is $wv^2 = .035 \times (31.4)^2 = 34.5$. Referring now to the diagram, Fig. 5, values of wv^2 are found on the left hand vertical scale. Obtaining the value 34.5 on this scale and following it horizontally to the single diagonal line running upward with an inclination toward the left, and then dropping down to the horizontal scale, gives a reading of 12.8 pounds as the centrifugal tension in one square inch of the belt. Since the working tension per square inch is $t = 300$ pounds, the effective tension of the belt will be $300 - 12.8 = 287.2$. This value of 287.2 pounds can now be found on the right hand portion of the horizontal scale where it is marked "effective tension." Now going vertically upward to a point on the diagonal line giving the value of $fa = .3 \times 180 = 54$, and then horizontally to the right across from the point last found, a reading of 175 will be obtained upon the right-hand vertical scale marked "turning force exerted by belt on pulley face." This is the value of p, the required turning force for a belt of one square inch cross section.

The area of the belt will therefore be:

$$A = \frac{P}{p} = \frac{438}{175} = 2.5 \text{ square inches.}$$

The total tension will be:

$$T_1 = A \times t = 2.5 \times 300 = 750$$

and,

$$T_2 = T_1 - P = 750 - 438 = 312 \text{ pounds.}$$

There is, as has already been found, a centrifugal tension of 12.8 pounds per square inch in the belt. Therefore, for the entire belt section:

$$\text{Centrifugal tension} = 12.8 \times A = 12.8 \times 2.5 = 32 \text{ pounds.}$$

Now, deducting this centrifugal tension of 32 pounds from each side of the belt, leaves, for the effective tensions:

$$750 - 32 = 718 \text{ pounds on the tight side}$$

and,

$$312 - 32 = 280 \text{ pounds on the slack side.}$$

The force, due to the belt tension which tends to force the pulley shaft against its bearing, is the sum of the effective tensions, and equals $718 + 280 = 998$ pounds.

The effective tension in the tight side of the belt can also be found directly upon the diagram without knowing the total tensions. This is done by assuming that the belt has no weight, and that there is therefore no centrifugal action, and accordingly taking the 300-pound vertical line on the scale of effective tension and finding its intersection with the diagonal marked 54, then going horizontally to the scale on the right—thus obtaining 183 pounds as the imaginary turning force per square inch of sectional area of belt. The sum of the total effective tensions in the tight side is

$$\frac{438 \times 300}{183} = 718 \text{ pounds.}$$

Results with Six-foot and Nine-foot Pulleys.

By substituting a 6-foot pulley, as shown in Fig. 6, for the 3-foot one, the following values are obtained by methods similar to those already used: $v = 62.8$ feet per second; $wv^2 = 138.16$; centrifugal tension $= 51$ pounds per square inch; $p = 152$; $P = 219$; $T_1 = 432$; $T_2 = 213$; $A = 1.44$ square inches; effective tensions $= 359$ and 140 pounds; and the horizontal pull against the pulley becomes $359 + 140 = 499$ pounds.

It may be noted here that, on account of increased centrifugal action, the belt has more than half as great a sectional

area as the one running half as fast and transmitting the same amount of power.

By the use of a 9-foot pulley, as shown in Fig. 7, this being three times as large a pulley as in Fig. 4, the following values are obtained: $v = 94.2$ feet per second; $wv^2 = 311$; centrifugal tension $= 117$ pounds per square inch; $p = 112$; $P = 146$; $T_1 = 391$; $T_2 = 245$; $A = 1.3$ square inches; effective tensions equal 239 and 93 pounds; and the horizontal pull $= 239 + 93 = 332$ pounds.

(To be concluded.)

* * *

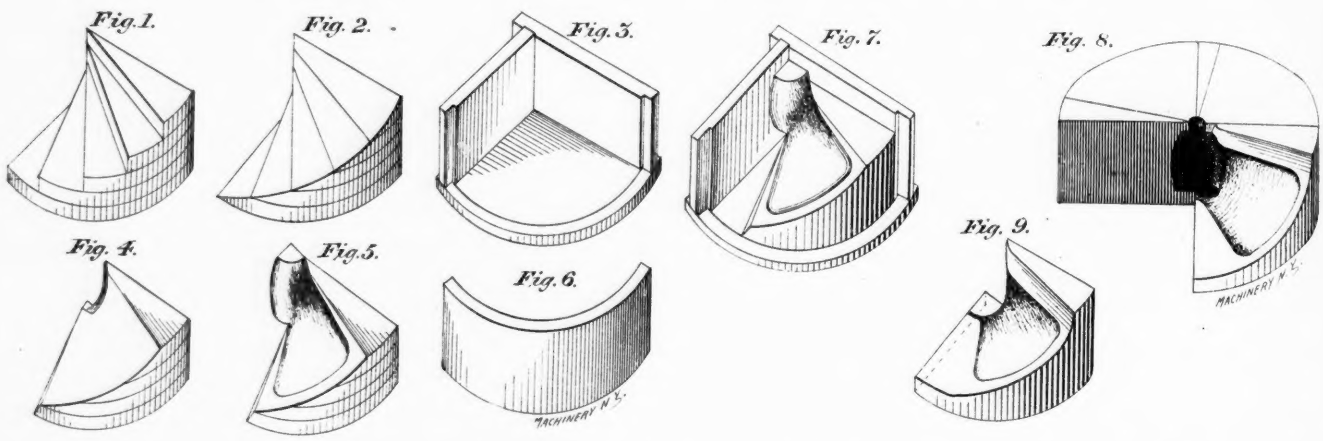
SCREW PROPELLERS.

SUGGESTIONS FOR THE CONSTRUCTION OF SMALL SCREW PROPELLERS.

I. McKim Chase.

In constructing small screw propellers, unless special precautions are taken in view of the frailty of the pattern, much difficulty will be encountered in making it retain its shape while being molded. In molding a wooden pattern of this kind it becomes necessary to provide a block or follow-board for the support of the pattern while the mold is being rammed up. This block is sometimes made of plaster of Paris, its form being obtained from the pattern itself.

In an establishment where many patterns of small screws of various forms were made, and where different methods of making and molding such screws were tried, that which insured the greatest satisfaction was first to make a block of wood whose helicoidal face represented the equivalent



of the screw desired. Upon this block the pattern for the blade was built, of alternate pieces of pine and baywood. The block was afterward employed to support the pattern while being molded. This method has special merit when the screw is of peculiar form and a correct casting is desired. By this method, also, the molding is done with green sand in a core box, a pattern of but one blade being necessary in order to obtain as many blades as may be required in the casting. It also insures the casting of all blades as nearly alike as it is practically possible to make them, and secures uniformity throughout the casting—which is very important when experimental data are required.

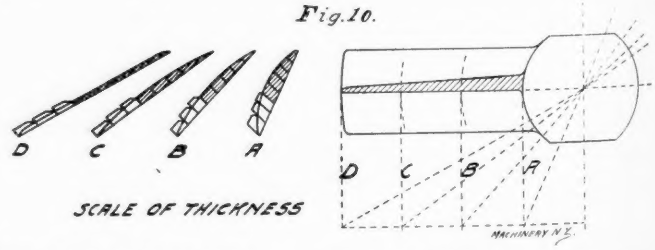
Fig. 1 shows the first step of the process, namely, that of making the block. This is made of about $2\frac{1}{2}$ inches greater radius than that of the pattern to allow for the joint of the mold. It is not necessary to make the block of the full dimensions of the box, but merely of sufficient width and depth to admit a joint around the outside of the pattern of the blade. If the screw is to be a true, or right one, as that illustrated, the block should be built up of pieces of equal thickness, the edges being straight and radiating from the center. Given the diameter and pitch of the screw, the first thing is to lay off a developed diagram of the periphery of the block, from which diagram are to be determined the thickness and width of the pieces that will constitute the block.

Suppose a true screw, of four blades 30 inches in diameter and 45 inches pitch, is required. Adding $2\frac{1}{2}$ inches to the radius for the joint of the mold will make the block $17\frac{1}{2}$ inches radius. One-fourth of the corresponding circumference will make the base of the triangle $27\frac{1}{2}$ inches, and one-fourth of the pitch will give an altitude of $11\frac{1}{4}$ inches. Dividing this last by ten will give $1\frac{1}{8}$ inch, the thickness of the pieces. Dividing the base by the same number gives $2\frac{3}{4}$ inches as the distance on the periphery that the edge of each piece must be set back of the piece below it when building up the block from the bottom. When preparing the pieces it is advisable to make them somewhat wider than their finished widths, as by so doing the joints can be more easily made. The surplus material may be removed after the block has been worked off.

In building the pattern of the blade, it is advisable to have the two outside edges of baywood. Beginning at the bottom, which will be the after edge of the blade, a piece of baywood is fitted to the block and tacked thereto in its proper position. A piece of pine is next fitted to the block, and, to make a close joint with the baywood strip to which it is to be glued, this pine piece is also tacked to the block. The other pieces which go to form the blade are prepared in a similar manner. As each piece is fitted, the thickness of the blade at that part is laid off on it and the back of the piece is chamfered to the line. The thickness can be obtained by laying down the sections of the blade as shown in Fig. 10. In order not to have the pieces too thin (in which case it would be more difficult to make good joints) it is advisable to shape the pieces as shown in Fig. 10. In this sketch the lower parts of the sections of the blade are shown built up with pieces somewhat thicker than the finished dimensions, with one of their sides chamfered to the finished line. The upper parts of the sections are represented as when reduced to finished size.

When all the pieces forming the blade are glued together and sufficiently dry, the pattern is removed from the block, its face smoothed, the outline of the blade laid off and the edges worked to the line. The back of the pattern is next worked off, and the whole then finished with shellac, when it is ready to be fitted to the hub. If preferred, the section of the hub can be fitted in its place on the block, and the pieces forming the blade fitted on at the same time that they

Fig. 10.



are being fitted to the block. There is little choice, however, between the two methods. The blade is to be secured to the hub by glue and screws. Sufficient margin for the joints of the mold is to be laid off on the block outside the blade, and the surplus material of the block removed. The pattern will then be prepared for the core box. This is made four or five inches deeper than the block and pattern, and should be made to be taken apart, as in Fig. 3. The angle of the core box is made according to the number of blades required in the screw. For a three-bladed screw, the box will extend

through 120 degrees; for a four-bladed screw, through 90 degrees, etc. The box should be made of two inch material, put together with screws, and the outside or circular end so arranged as to admit of easy removal.

Before beginning the mold, it is necessary to provide a skeleton of cast iron for building in the cores for the drag parts of the mold, and skeletons also for the copes; all these should be provided with suitable lifters.

When beginning the mold, the block with the pattern being in the bottom of the box, the remainder of the box is rammed up with green sand, the skeleton having been properly placed in the mold during the operation. The drag being completed, the box is inverted and the block which supported the pattern removed, leaving the latter in the mold. The parting having been prepared and the gates and risers properly arranged, the operation of ramming up the cope is proceeded with. The skeleton for the cope, as well as having lifters, must be provided with prickers or wires extending to within a half-inch of the pattern and joint of the mold. The purpose of these is to support the sand. The cope being completed, the sides and end of the box are removed, the cope lifted off and held suspended, the pattern withdrawn, and the mold dressed. A bed having been prepared, the drag is lifted from the bottom board and placed on the bed and the cope placed upon it. One-fourth of the mold is now complete, as illustrated in Fig. 8. In the same way the other sections of the mold are prepared. When all parts of the mold are in place they are weighted with plates made for the purpose and conforming in shape to the sections of the mold. A curb of thin boiler plate bent to a circular shape, with flanges turned outwardly and radially for bolting together, is made to encircle the mold. The space between the mold and the curb is rammed with sand, and after the pouring gate is prepared the mold is ready to be poured.

In making the core box it is advised that it be made of sufficient radius to answer for the largest screw likely to be wanted. Screws up to four feet in diameter have been successfully made by this method. When small screws are to be duplicated it is best to have a metal pattern and do the molding in a flask. The metal pattern can be advantageously made, as the foregoing explains.

* * *

EXAMINATION FOR EMPLOYMENT AT THE NAVY YARDS.

An examination was held recently at the Brooklyn Navy Yard for the position of quarterman electrician, which is the name given the general foreman of equipment shops.

As will be seen by the following order, and later by the examination questions, this position requires a superior man, and none but those in that class should compete. Of course, the pay is good and demands a first-class man, and in the opinion of the writer, none could so well fill such a position as a well-educated engineer-machinist. The experience of such a man as a machinist, as an engineer in charge of men—which necessitates the possession of executive ability—his knowledge of first principles of mechanics and his ability to do clerical work, such as making out reports, etc., would amply fit him for the position referred to.

We know there are many readers of this magazine who are qualified to hold a position like this, and it is to give such an idea of what is required that this article appears. It further goes to show that it is only the educated mechanics who can reasonably expect to make progress and succeed to responsible positions in their chosen vocations.

The following is the order relating to the examination:

NAVY YARD ORDER NO. 193.

EMPLOYMENT OF LABOR AT NAVY YARDS.

NAVY DEPARTMENT,
March 11, 1901.

1. An examination of applicants will be held at the Navy Yard, New York, March 27, 1901, or as soon thereafter as practicable, for filling the following position:

Department of Equipment.

Quarterman Electrician.........................$4.56 per diem.

The trades employed comprise electrical machinists, machinists, tool makers, pattern makers, cabinetmakers, carpenters, painters, electroplaters, buffers, firemen, and helpers. The work consists of the manufacture or repair or installation as required of generating sets, switch boards, wiring appliances, search lights, motors, navigation instruments, etc. The greater part of the work is manufacturing and mechanical repairs. Executive ability is absolutely essential. *Extensive electrical experience* is not required, but a thorough mechanical knowledge is necessary. *Mechanical qualifications* will be given greater weight than electrical.

2. The examination will be open to all comers who can give evidence of experience in the kind of work for which they seek employment, and who are citizens of the United States. Persons now holding positions at the yard will be admitted to competition on the same footing as other applicants.

3. Applications will be addressed to the "Commandant, Navy Yard, New York," and must be delivered to him on or before Tuesday, March 26. No application received after that date will be considered.

4. Each applicant will state in his application his name, age, residence, citizenship, present occupation (stating shop and position therein), and previous employment or work done.

5. The applications will be accompanied by evidence of citizenship, and by certificates, preferably from previous employers, as to character, habits of industry and sobriety, and skill and experience in conducting work of the kind required.

6. A Board of Examiners will convene at the Navy Yard, New York, on the 27th day of March, or as soon after as practicable.

7. *Applicants will be informed of the date upon which they will be required to report for examination.*

8. The Commandant will acknowledge the receipt of each application, enclosing a copy of this order, and inviting attention to paragraph 7.

9. The examination will be practical in character, having reference exclusively to the requirements of the position to be filled, which will comprise the direct charge, under the general direction of the proper authorities, of the working force of the electrical workshop, equipment department, Navy Yard, New York.

10. The applicant's antecedents and experience in his trade, as well as the character of his previous work, will be duly considered by the Board in making its recommendations.

11. The Board will make sufficient inquiry to ascertain that the applicants recommended are fit for the work; that they have enough education to make the required reports, estimates and calculations; that they are of reputable character, and of sober and industrious habits, and that they have not been convicted of crime or misdemeanor.

12. At the close of the examination the Board will make a report, through the Commandant, to the Secretary of the Navy, showing the comparative merit of the applicants for the vacancy and designating the name of the individual who, in its opinion, is best qualified for the place. If the Board reports none of the candidates for the position as qualified, a new examination will be held, and the position will remain open until qualified candidates are secured. The record of proceedings of the Board, with all applications, certificates, and other papers, will be forwarded to the Department.

JOHN D. LONG,
Secretary.

Following are the questions given in the written examination?

1. Name the different tools which a modern machine shop should be equipped with.

2. A hollow shaft (steel assumed) is 20 feet long, 16 inches external diameter, and $7\frac{1}{2}$ inches internal diameter. What is the weight of this shaft?

3. In planing a slide valve and seat, would you plane with, or across, the direction of motion; and why?

4. A shaft with a 30-inch pulley runs 80 revolutions per minute. The countershaft is to run at 200 revolutions per minute. What size pulley will be required?

5. The diameter of a wheel and the number of teeth being given, give rule to find the pitch of the teeth.

6. Define what is meant by the pitch line of a wheel.

7. What is an electric magnet?

8. What is a dynamo, and name the principal parts.

9. What relation exists between volts, resistance and amperes in an electric circuit?

10. Explain how you would babbitt a pair of crankpin brasses that had not been babbitted previously. State the time consumed, and cost.

11. Name the different metals used in bearings, with the distinctive features of each set forth.

12. Give what you consider the duties of a foreman. How would you manage the men under your charge? How would you keep the time, and an account of the material worked up and on hand; also that received from time to time? Write an essay on the foregoing.

In addition to the foregoing questions, which required a written answer, the following verbal questions were given the candidates:

1. Give a detailed description of how bolts and nuts are made.

2. Explain the movement of the centrifugal governor as used on the high-speed engine.

3. (*a*) Explain how the flanges of copper pipes are affixed. (*b*) How is expansion taken care of in such pipes? (*c*) How is condensation disposed of?

4. A crankshaft of an electric light engine is broken (cracked) in two or more places. Would you repair this shaft (assuming repairs possible) or would you condemn it and order a new one?

5. How are armatures wound and insulated, and how are the wires held in place?

Let the interested reader try himself on the foregoing questions.

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A practical Journal for the Machine Shop.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

JULY, 1901.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify this statement.

1900.		1900.		1901.		1901.	
Aug.....	21,500	Nov.....	25,000	Feb.....	26,500	May.....	26,500
Sept.....	21,750	Dec.....	27,500	March...	30,000	June....	28,000
Oct.....	24,000	Jan.,1901	27,500	April....	26,000	July.....	28,964

THE STRIKE SITUATION.

It is impossible at this writing to predict how far the strike of the machinists for a 9-hour day will be successful. Some shops have granted the shorter day with the same pay as formerly, others positively refuse to make such a concession, while still others have effected a compromise. In many instances the employes are holding out solidly for their demands, while reports have been published of firms continuing with new men or with their former employes under the old conditions.

In some quarters the strike has taken a more serious aspect, as it has grown into a battle for and against the machinists' union, this contention being scarcely secondary to the efforts for the 9-hour day.

When the New York agreement was drawn up, a year ago, between the officers of the Metal Trades Association and the International Association of Machinists, there was no explicit understanding about wages. The agreement stipulated that the 54-hour week should go into effect at the works of the members of the Metal Trades Association on May 20, last, and that differences should be submitted to arbitration, and settled by this means if possible. No reference whatever to the rate of wages was contained in the text of the agreement. Machinists naturally want the 9-hour day with the same pay as formerly, while this demand has been quite generally opposed, and attempts to settle the question amicably, by arbitration or otherwise, have been unavailing.

During the past month the manufacturers have been in session at New York and the machinists at Toronto, and the results of these meetings have been to strain the relations between the two organizations still further, rather than otherwise. In issuing the call for their convention, the Metal Trades Association asked the machinery manufacturers of the country to meet with them for decisive action with regard to the machinists' union, and many accepted, and later joined the association. The claims made were that the union had not shown itself willing to keep its pledges to arbitrate, and that demands were being made with regard to the production and management of the shops contrary to the terms of the New York agreement. Counter claims were issued by the International Association of Machinists to the effect that the employers had not kept faith with them in asking a reduction of wages to accompany the reduction in hours. It was claimed that strikes in force at the time of the agreement had been settled with the understanding that the shorter hours were to come without decreased wages.

As bearing upon a situation like the present it is interesting to take a long-range view of things, apart from the events of the present strife, and try to judge in what direction the tide of industrial progress is sweeping. It is rather startling to know that less than 80 years ago it was unlawful in England for labor to combine for protection, although employers could combine; that a hand worker was compelled to work for whoever first employed him, and for whatever he chose to pay; and that 14 to 16 hours a day was the rule. During these 80 years the hours of labor have been reduced from a third to a half, and wages have greatly increased in spite of occasional setbacks extending over periods of a few years at a time.

This has been the general tendency of the past 80 years, and the reason for it is largely because of the introduction of machinery, the multiplication of industries, and the cheapening of products, thus increasing the demand for them. The most active agents in this change have been the employes of the machine shops where the machines that have made industrial progress possible have been worked out. Through their efforts there has been a gradual reduction in working hours, with an increase—or, at least, without a decrease—in wages; and during the past decade in particular, there has been notable progress in the direction of shorter hours among the different trades. It is a little singular, therefore, that the machinists, who have contributed so much to this end, should have been among the last to agitate the question of the shorter day.

We believe that the tendency noted above will continue, that the 9-hour day will be an accomplished fact for machinists as for others—if not this year, in the near future—and that it will eventually come without a reduction in pay. We firmly believe, moreover, that it can only come through hearty co-operation of employer and employe, both aiming to keep the cost of production down to a point where the employer can make the necessary 10 or 12 per cent advance that the change would entail, without serious loss. It is to be regretted, on this account, if for no other, that the relations between the Metal Trades Association and the International Association of Machinists have become so strained and so much bitter feeling has been engendered on both sides. When this condition exists, neither side is in a frame of mind to do their part toward bringing about the change, which, we believe, will eventually come.

* * *

THE USE OF BINDER PULLEYS.

In transmitting power by belt from one shaft to another the amount of power conveyed is governed by the tension of the belt, its speed, and the arc of contact of the belt on the smaller pulley. Other conditions being the same, it is assumed that the larger the arc of contact the more efficient the belt transmission will be. According to the common theory of belts, about 50 per cent more power can be transmitted when the pulleys are of the same size, giving an arc of contact on each of 180 degrees, than when one pulley is larger than the other and the contact on the smaller pulley is, for example, only through an arc of 90 degrees. Following this reasoning, many engineers advocate the use of binder pulleys to increase the arc of contact to considerably more than 180 degrees, and these may be employed to increase the contact on either the driving or driven pulley, or both. There have been numerous large power installations on this plan, one of which is at the works of the Brown & Sharpe Manufacturing Company, Providence, R. I., and was recently referred to in these columns. This system of power transmission with the use of binder pulleys is commonly known as the Hill system, and appears to give good satisfaction, although we think its relative merits and the office of the binder pulleys, their effect on the power transmitted, and the wear of the belt, etc., are not generally understood. In this number we publish the first instalment of an article upon this subject by Prof. Forrest R. Jones, the author of the well-known textbook upon

machine design. This is the first time, so far as we know, that the question of power transmission, both with and without binder pulleys, has been discussed in print. Those who have to do with power transmission will be interested in what Prof. Jones has to say on the subject, and those who are not at present interested should carefully preserve the articles for future reference.

* * *

NOTES AND COMMENT.

What is said to be the first iron railway bridge to be constructed anywhere in the world has recently been torn down and replaced by a new structure. This bridge was built in 1823 on the Stockton & Darlington Railway, England. It was composed entirely of cast iron, and is generally believed to have been built by George Stephenson.

The elasticity of the English language is well understood, but sometimes the application of the name of a well-known object to some special mechanical appliance leads to confusing and ridiculous conclusions on the part of the uninitiated. A correspondent to a musical journal, hearing that an inventor had devised a new trolley harp, at once concluded that it was a new musical stringed instrument for the edification of trolley parties, and made special mention of it for his publication.

Although the ignorance of a man who attempts to palm himself off as a first-class machinist without having the necessary qualifications is not usually laughable, but, on the contrary, painful to the right-minded observer, an instance has come to our knowledge which is somewhat amusing. A man was hired into a certain shop as being a competent lathe hand. He worked along fairly well for a few days until given a piece of taper turning which apparently was quite beyond his depth. Some one seeing him in trouble advised him to set over the tailstock of his lathe to get the required taper. His astonishment can be imagined when a few minutes later he saw the alleged machinist with a bar attempting to move the tailstock end of the lathe over on the foundation.

One of the irritating trials of the editor's life is the small errors which occasionally crop out in the text when too late for rectification. Mathematical calculations and formulas are almost fiendish in this respect. A misplaced figure or an omitted word or mathematical sign changes the entire sense without leaving the reader a chance to supply the obvious meaning from the context. Again errors occur which can be attributed to incorrect copy. A calculation may be made involving several factors or a series of calculations may be hastily made and only one used for purpose of illustration and copied for the text. Confusion may result with a consequent bald error, perhaps of minor import, but nevertheless irritating. As an example, our attention has been called to such an error which appeared in the June issue in answer to question 35. The sentence next to the last at the bottom of the second column, on page 56, should read: "For a 1-inch screw the theoretical lifting force would be $301.69 \times 8 = 2413.52$ times the force on the end of the wrench."

An event that excited a great deal of interest in the vicinity of the great lakes was a race between the steamers *Erie* and *Tashmoo*. The course lay between the cities of Cleveland and Erie, a distance of about 100 miles, and the victorious *Erie* defeated her rival by only 45 seconds, the speed of the boats being about 23 miles an hour. During part of the course the *Tashmoo* led the *Erie*, and it was "anybody's race" until near the finish. The *Erie* is the heavier boat, draws the more water, and is intended for lake service. The *Tashmoo* is a river boat. It has been claimed by those interested in her that she was faster than any boat on the lakes. During the race the *Tashmoo* had the undoubted advantage in shallow water, owing to her lighter draft, but in deeper water the *Erie* showed her superiority. Probably there has never been a race of any kind through so long a distance where the contestants have been so evenly matched as in this instance.

Shops having to do a great deal of repair work on dirty greasy machine parts will find it to their advantage to improvise a boiling tank for the removal of dirt and grease from the smaller parts before the repairs are made. The saving of cotton waste and the added comfort and convenience of the men, to say nothing of their appearance, makes it a good investment. The tank may be constructed of sheet iron or steel and the heat supplied by a steam pipe from the boiler. The pipe should discharge directly into the water contained in the tank. A few pounds of potash or concentrated lye will at a boiling temperature thoroughly clean a large quantity of greasy parts in a manner far superior to any other process and with very little labor.

THE POWER PLANTS OF NEW YORK.

New York City has in operation or process of erection the four largest central power stations in the world. The first one completed was the Metropolitan Street Railway station at 95th and 96th Sts. and East River; the second is the Third Avenue Street Railway station at Ninth Ave. and 216th St.; and the two in process of erection are for the New York Gas and Electric Light, Heat and Power Company at 38th St. and First Ave., and for the Manhattan Elevated Railroad at 74th and 75th Sts. and East River. The Metropolitan station will have eleven units of 5,000 nominal H. P., total maximum rating about 66,000 H. P.; the Third Avenue station has sixteen 4,500 H. P. engines, giving a nominal total rating of 72,000 H. P., but which can be pushed to 100,000 H. P., should occasion arise making it necessary. The station for the New York Gas and Electric Light, Heat and Power Company will have eight 6,000 H. P. superheated steam engines, and the new station for the Manhattan Elevated Railroad will have eight 8,000 H. P. engines. The E. P. Allis Company, Milwaukee, Wis., and the Westinghouse Machine Company, Pittsburg, Pa., have equipped or will equip all these immense power stations, having an aggregate of over 300,000 maximum horse power.

THE EDISON STORAGE BATTERY.

During the last few weeks wild claims have been put forth in the daily press in relation to the new Edison storage battery, but as a matter of fact the actual merits of the invention cannot be determined until it has withstood the test of time. As some men have rather hazy notions as to the nature of storage batteries it may be well to state that they are simply apparatus in which energy is stored, and being such, they can, at the most, only give back what is put into them. In actual practice they cannot give back this much, for there is a certain loss in the act of charging as well as in the discharge; but in the batteries now in use, this loss is reduced to a small percentage, between five and ten per cent, under average conditions.

The direction in which storage batteries can be improved is in durability and weight. The batteries now in use are made of lead and weigh all the way from 170 pounds down to about 50 pounds per horse power hour, the latter figure being claimed for some of the light automobile batteries. The portion of the battery in which the energy is stored weighs about 12 pounds per horse power hour, and the balance goes into the supporting frames, or girds as they are called, and the containing vessels. By reducing the weight of these parts, the battery is made lighter, but as can be readily seen, it is also made weaker; hence lightness is obtained by sacrificing durability.

The Edison battery is made of iron and nickel, and is said to weigh about 53 pounds per horse-power hour. If after a year or so of actual service, it is shown that the deterioration is not any faster than in lead batteries of double the weight, then their superiority over the latter for all portable service will be demonstrated, assuming, of course, that they are sold at about the same price. If 53 pounds is the average weight for batteries intended for use in stationary plants, then it is probable that a considerable reduction could be made in designs intended specially for portable work, and this would make them decidedly valuable for automobiles. But, as stated above, only the test of time can determine the merit of the battery.

W. B.

THE NEW METHOD OF COMPOUND INDEXING ON THE UNIVERSAL MILLING MACHINE.

JOHN T. GIDDINGS.

There has been discovered another method of compound indexing on the milling machine which is much shorter than the method in common use and consequently saves considerable labor. This method has not been explained in the columns of MACHINERY, but O. J. Beale, of the Brown & Sharpe Mfg. Co., has called attention to it in the *American Machinist*, and a complete table giving divisions up to 250 was contributed to the same publication by W. G. Luper. of the Mare Island Navy Yard. This table was compiled by F. H. Sovereign and corrected and proved by the Brown & Sharpe Mfg. Co.

As this matter of compound indexing is interesting and valuable to mechanics and toolmakers generally, a contribution on this subject may prove of interest also to the readers of MACHINERY. The method consists in gearing the index plate to the spindle of the spiral head so that, on withdrawing the anchoring pin, the index plate is given a movement either in the same direction as the index crank or opposite to it, making the actual movement of the index crank different from the apparent one. To use this method an arbor is needed which projects from the back of the spiral head, so as to place the change gears on it, and two extra gears of 46 and 80 teeth are all that is required for up to 250 divisions.

By rotating the index plate at the same time that the crank pin is moved, the crank moves through a longer or shorter arc than indicated by the sector, and the index reckoning number is changed. This number is 40 when the plate is locked, as 40 turns of the worm make one turn of the spindle. If the spindle is connected by gearing to the worm, by two gears having the same number of teeth, with one intermediate gear or idler, the plate rotates once in 40 turns of the crank in the same direction as the crank, and the index number is 39; and one whole turn of the crank, with reference to the index plate, would give 1-39 of a division of the spindle, instead of 1-40.

If two idlers are used so as to give the index plate an opposite movement to the crank, the index number would be 41. The effect of this in both cases is the same as if the worm gear had 39 and 41 teeth for purposes of calculation instead of 40.

The advantage of this method is that when indexing for prime numbers the regular index for the nearest even number can be used, and it is only necessary to go around the gear once, thus cutting the teeth consecutively. In some cases the index reckoning number is a fractional one, but this is not at all inconvenient.

The shortest way to make the calculation by this method is by means of a formula.

Let a = number of divisions selected.
" x = " " " required.

If a is less than x two idlers are required. If a is greater than x one idler is required.

$$\frac{a \div 40}{a - x} \begin{array}{l} = \text{number of gear to be used on index plate.} \\ = \text{" " " " " " " spindle.} \end{array}$$

If x is greater than a it can be subtracted algebraically and would be negative. In such cases the minus sign indicates that two idlers should be used. For example: Required to set the index for 51 teeth or divisions. Suppose we select the indexing for 50 teeth, then $a = 50$, $x = 51$.

$$\frac{50 \div 40}{50 - 51} = \frac{1\frac{1}{4}}{-1} = \frac{5}{4}.$$

Multiplying both terms of this ratio as in the calculation for change gears in screw cutting,

$$\frac{8 \times 5}{8 \times 4} = \frac{40}{32} \begin{array}{l} = \text{gear on index plate.} \\ = \text{gear on the spindle.} \end{array}$$

And as x exceeds a, two idlers are required. To prove this is correct we need to have the index reckoning number.

$$40 - \frac{\text{gear on spindle}}{\text{gear on plate}} = \text{index reckoning number when } a \text{ exceeds } x.$$

$$40 + \frac{\text{gear on spindle}}{\text{gear on plate}} = \text{index reckoning number when } x \text{ exceeds } a.$$

In our example, as x exceeds a, this number is 40 + 32-40 = 40 4-5. Now, as we have indexed for 50 teeth, multiplying the crank movement for 50 teeth, which is 40-50 by 51, should give the index reckoning number.

Thus 40-50 × 51 = 40 4-5, which is correct.

For another example: Required the indexing for 53 teeth. Select 56 for a. Then,

$$\frac{56 \div 40}{56 - 53} = \frac{7\text{-}5}{3} = \frac{7}{15} \begin{array}{l} = \text{number on index plate.} \\ = \text{number on spindle.} \end{array}$$

$$\frac{4 \times 7}{4 \times 15} \begin{array}{l} = 28 \text{ on index plate,} \\ = 60 \text{ on spindle.} \end{array}$$

If it was not convenient to use these gears, they could be compounded thus:

$$\frac{28}{60} = \frac{7 \times 4}{5 \times 12} = \frac{56 \times 24}{40 \times 72} \begin{array}{l} = \text{gears for plate (driven),} \\ = \text{gears for spindle (drivers),} \end{array}$$

and as 72 and 40 are the drivers, in this case we place either the 24 or 56 on the plate. Say 56, then the first gear on the stud could be 40 and the second 24 and 72 on the spindle. No idler is required in this case, as the compound gears serve the purpose of an idler.

For proof, index reckoning number = 40 − 15 7 = 37 6-7, the crank movement for 56 teeth = 40-56 . 40-56 × 53 = 37 6-7.

Again, suppose it was required to graduate a dial to indicate thousandths of an inch for the cross feed of a lathe of 6 threads per inch. 1-6 = 166 2-3 spaces to one turn.

Number selected = 160, then,

$$\frac{160 \div 40}{160 - 166\frac{2}{3}} = \frac{4}{-6\frac{2}{3}} = \frac{12}{20} = \frac{24}{40} \begin{array}{l} = \text{gear on plate,} \\ = \text{gear on spindle,} \end{array}$$

and as x exceeds a, two idlers are required.

Proof: Index reckoning number is 40 + 40-24 = 41 2-3. 40-160 × 166 2-3 = 41 2-3.

The calculations may be made without the above formula as follows:

Assume some number of turns of the crank that are near the required number of divisions, and multiplying these turns by the required number of divisions, the result is the index reckoning number. If the assumed number is less than the required one, two idlers are required and the index reckoning number is greater than 40. And if the assumed number is greater than the required one, but one idler is required and the index reckoning number is less than 40. For example: Required 67 divisions, assume 70. Then 40-70 × 67 = 38 2-7 = index reckoning number. 40 − 38 2-7 = 1 5-7 and the ratio of gear is 1 5-7 to 1. = 12-7 = 48-28; and considering the spindle gear as the driver, place 48 on the spindle and 28 on the plate with one idler.

Again, required 71 divisions. Assume 70. 40-70 × 71 = 40 4-7 = index reckoning number. 40 4-7 − 40 = 4-7 = ratio of gears = 32-56, and 32 on spindle and 56 on plate is required with two idlers.

This method of indexing is not applicable to spiral gears at present, as the spiral is obtained through the gears used to modify the indexing.

* * *

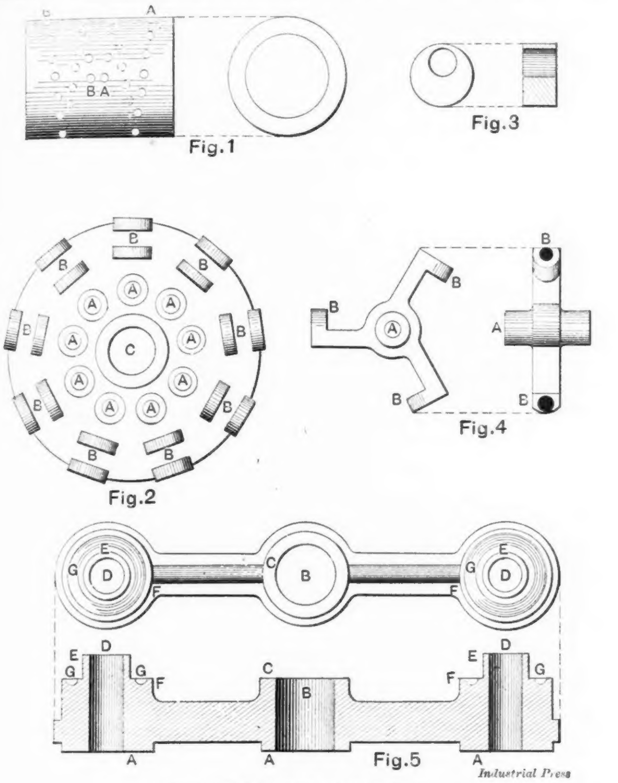
Under the same pressure a clean brass or lead pipe will generate a much greater velocity of flow in any fluid than a clean iron one, all other conditions being the same. The difference is ascribed by Sullivan in his "New Hydraulics" to the difference in specific gravity of the metals composing the pipes. It does not follow, however, that this comparison holds between all substances. It does hold between the metals and in general between the various grades of one specific substance. Thus the metals may be compared and the advantage will be found with the denser ones. But there are substances much lighter than metals which give a greater flow with the same head. Thus, an asphaltum coated pipe will carry considerably more water with the same head than an ordinary plain pipe. There are various grades of asphaltum and the purer qualities are found to give the best results. So it is apparent that comparing different grades of the same substance, or related substances, the advantage in friction coefficient will be in favor of the denser one.

TOOLS FOR INTERCHANGEABLE MANUFACTURING.—3.

NOVEL AND MISCELLANEOUS DRILL JIGS.

JOSEPH VINCENT WOODWORTH.

Having in the two preceding articles fully described the most expedient means for accomplishing accurate results in the more familiar class of drill jigs, we will show in this article a number of jigs of a special and novel design



Sketches of Pieces to be Drilled.

Fig. 6 shows two views of a drill jig used for drilling the holes *A A* and *B B* in the roller Fig. 1. As will be seen, the two sets of holes are drilled entirely around on a $\frac{3}{4}$-inch pitch spiral, right and left respectively. When finished the rollers have hardened pins inserted in the holes, and act as cams for moving small slides of an automatic machine.

The jig, Fig. 6, although simple in design and construction, is very accurate in production, and possesses some novel features seldom met with in drill jig design. The jig consists of the body casting of which *A A* are the legs, and *B* the bushing and pin plate. The roller to be drilled is fastened on the spindle *D* by the nut shown. This spindle moves freely in the casting at *C*. The right and left worms *I* and *J* are cut to a $\frac{3}{4}$-inch pitch, and are fastened to the spindle. The indexer *K* is of machine steel, is indexed to 26 and fastened to the spindle by the setscrew *L*. The index pin *Q* is fastened within the bracket *P*, and is finished on the end to fit the index notches in *K*, the spring *R* keeping it down tight. The worm stud *O*, of tool steel, is finished to fit the worm snugly, the head is knurled, and it is then hardened. The end of the spindle *D*, on which the work is fastened, is finished with a shoulder at *E* and two smaller ones at *F F*, the space between these two being reduced to a size sufficiently small to allow for clearance for the drill as it comes through the work. The drill bushing *T* is let into the top *B*, so that when the spindle projects to its furthest point the first hole drilled will be the exact distance required from the end of the work.

When in use the work is fastened on the spindle and the index pin *S* is placed in the first notch of the index sleeve *K*; that is, in the position shown in Fig. 6. The first hole is then drilled. The index pin is now entered into the next notch and the next hole drilled. And so on until a complete circle of holes has been drilled entirely around the work, the stud *O* in the worm feeding the spindle back as the holes are drilled. As the last hole in the first circle of holes is drilled the spindle is slid in by hand and the stud *O* enters the worm *I*. The spindle is then revolved in the opposite direction, and the other circle of holes drilled in the same manner as the first. The work is then removed, and the spindle fed back to the starting point. Another roller blank is then fastened on the spindle, and the operations repeated as before. This jig can be adapted for the drilling of holes, on a given pitch, in circular pieces of work, by simply substituting worms of the pitch required, and changing the index sleeve. To expedite the drilling, where a number of circles of holes are to be drilled in the work, bushings to the number of circles required may be used. The one thing necessary is to have them spaced and located exactly the same distance apart, which should be the same as the pitch of the worm.

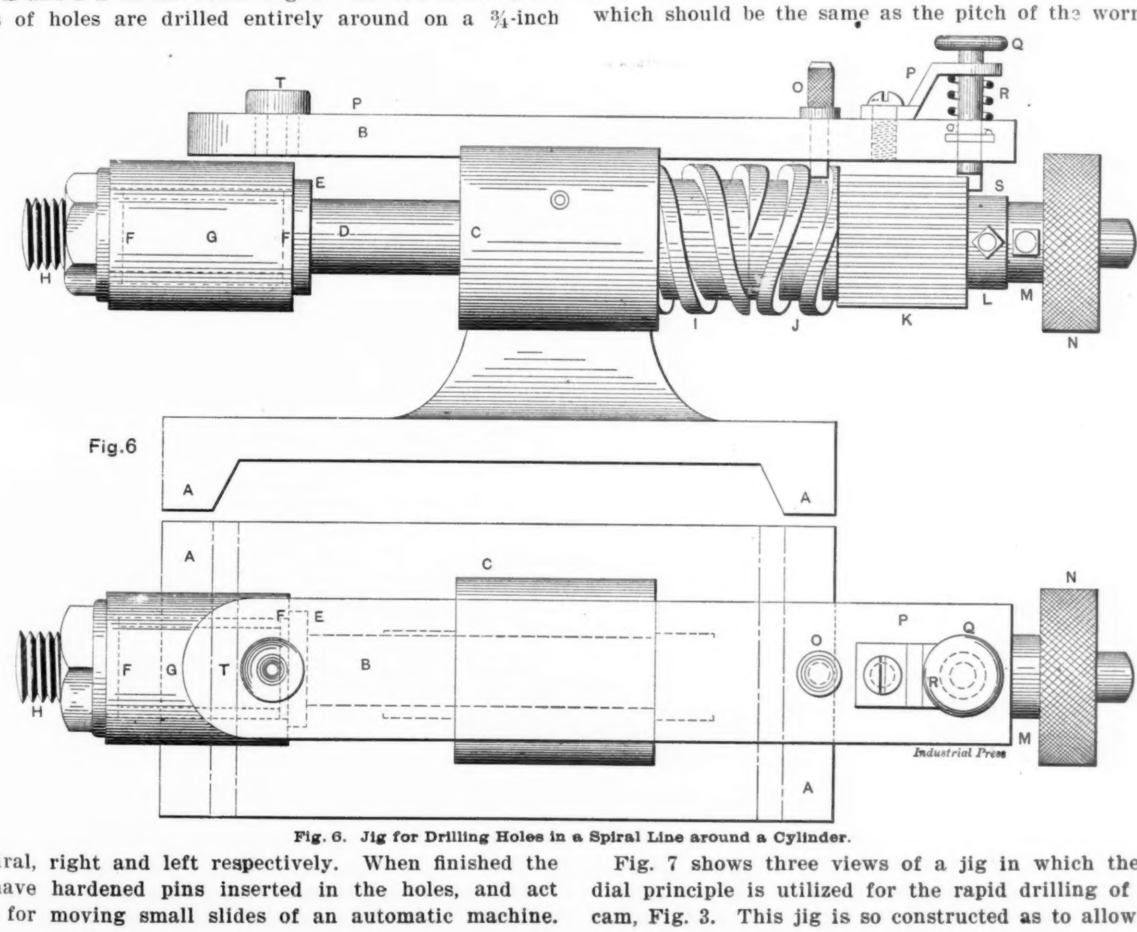


Fig. 6. Jig for Drilling Holes in a Spiral Line around a Cylinder.

Fig. 7 shows three views of a jig in which the indexing dial principle is utilized for the rapid drilling of the small cam, Fig. 3. This jig is so constructed as to allow the work

when finished to be self-releasing. It consists of a body casting *A*, planed and finished on all sides, and having the legs *B B* scraped. It is bored to admit the stem *D*, of the index and receiver plate *C*, which has eight holes *F*, bored and finished to allow of the work to be drilled fitting nicely within them, and thereby acting as receivers. The four holes *L* are the index or spacing points, and are all reamed to exactly the same size. The bushing plate *H* is fastened by the dowel pins *I I*, and the two capscrews *J J*. This is done before locating and finishing the bushing holes. The bushings *K K* are let into the plate *H*, as shown, and are ground and lapped to size. Care is necessary in the locating and finishing of the bushing holes to get them in the exact position required, as it is necessary to have the holes in the cams eccentric to a given size. The index pin *P* fits snugly in the hole in the plate *M;* and the holes *L* in the index or receiving plate. The spacing and locating of all holes for the bushings, index pin, and receivers for the work are accurately accomplished by the button method on the dividing head of the universal milling machine, in the manner described in the preceding article. The receiver holes *F* are all finished to size with a special reamer.

When in operation one of the pieces to be drilled is placed in each of the eight holes or receivers *F*. The dial is then fed around until the first two pieces are under the bushings *K K*, when the index pin *P* is entered into the hole *L*, and the two pieces of work are drilled. The index pin is now removed, the dial revolved one space, and the index pin re-entered. This brings the next two pieces under the bushings. The first piece drilled drops through the jig at *R*, the bottom of the jig being cut away at this point, as shown by the dotted lines. The second piece drilled remains at *G*. Now the dial is moved around and the empty receivers are filled, as the finished work drops out. As will be readily seen, the design of this jig allows of the continuous drilling of the work, without loss of time in the removal of same when finished. Moreover, the placing of the work in the empty receivers can be accomplished very rapidly, which is one of the best features of the jig, as this part of the work is quite a factor in the rapid handling and production of small parts by drilling. This jig can be used to advantage for the drilling of holes in small parts which have been previously machined to a uniform size. For the drilling of work in which great accuracy in the product is desired the indexing or spacing holes in the dial should be equipped with hardened steel bushings, which should be lapped to a size allowing of a snug fit for the index pin, thus allowing for the accurate locating of the work and the positive fastening of same while being drilled.

Jigs with Indexing Plates.

In the jigs shown in Figs 8 and 9, respectively, we have two more adaptations of the indexing dial principle, although each of the jigs is used for the drilling of a separate and distinct class of work, and possesses features and attachments, which in design and construction are not found in any of the jigs previously shown. That shown in Fig. 8 is used for drilling all the holes (except the center one *C*) in the spider casting, Fig. 2; that is, those marked *B* and *A*, through the projecting lugs. The design of this jig is clearly shown in the three views, and the method of construction can be readily understood from the description of the others. When in use the casting, Fig. 2, is fastened on index plate *H*, Fig. 8, by entering it on the stud *K*, and then fastened by a nut at *L*. It is located against the small projecting piece *O*. The index pin *U* is then entered in one of the holes *N* by feeding the index plate around the desired distance by worm *C*. The hole through one of the projecting lugs *B*, Fig. 2, is then drilled through bushing *P*. The jig is now stood on the legs *R R R R*, and one of the holes *A* is drilled through bushing *Q* at the back. Index pin U is pulled out, the dial fed around one space, and the next two holes are drilled. Index pin *U* is equipped with a spring which keeps it tightly down on the plate. The nine holes *M* are clearance holes for the drill and are finished slightly larger than the hole in bushing *Q*. The index plate *H* is a good fit between the front and back of the jig to allow it to revolve freely without play on the face of the jig. The bearings for the worm shaft are cast on the jig at *B B*. The main casting is cut away at *E*, as shown, in order to allow of the handle *F* revolving freely.

This jig can be used for drilling a number of different sizes of castings of the same shape; that is, with the number of projections reduced or increased by changing the index plate, or, better still, by finishing it with a number of different circles of holes. This will allow of indexing for any number of holes—in the casting to be drilled—within the capacity of the circles. The jig is a very rapid and accurate producer for the drilling of regularly spaced holes in castings of a circular or irregular shape. The use of the worm for revolving the index plate, although not absolutely necessary, is far preferable—whenever the quantity of work to be drilled will allow of the extra expense—to the usual way of revolving the plate by hand; for by having the worm a fair fit in the hobbed rim of the index plate, it contributes to the strengthening and rigidity of the plate while the work is being drilled.

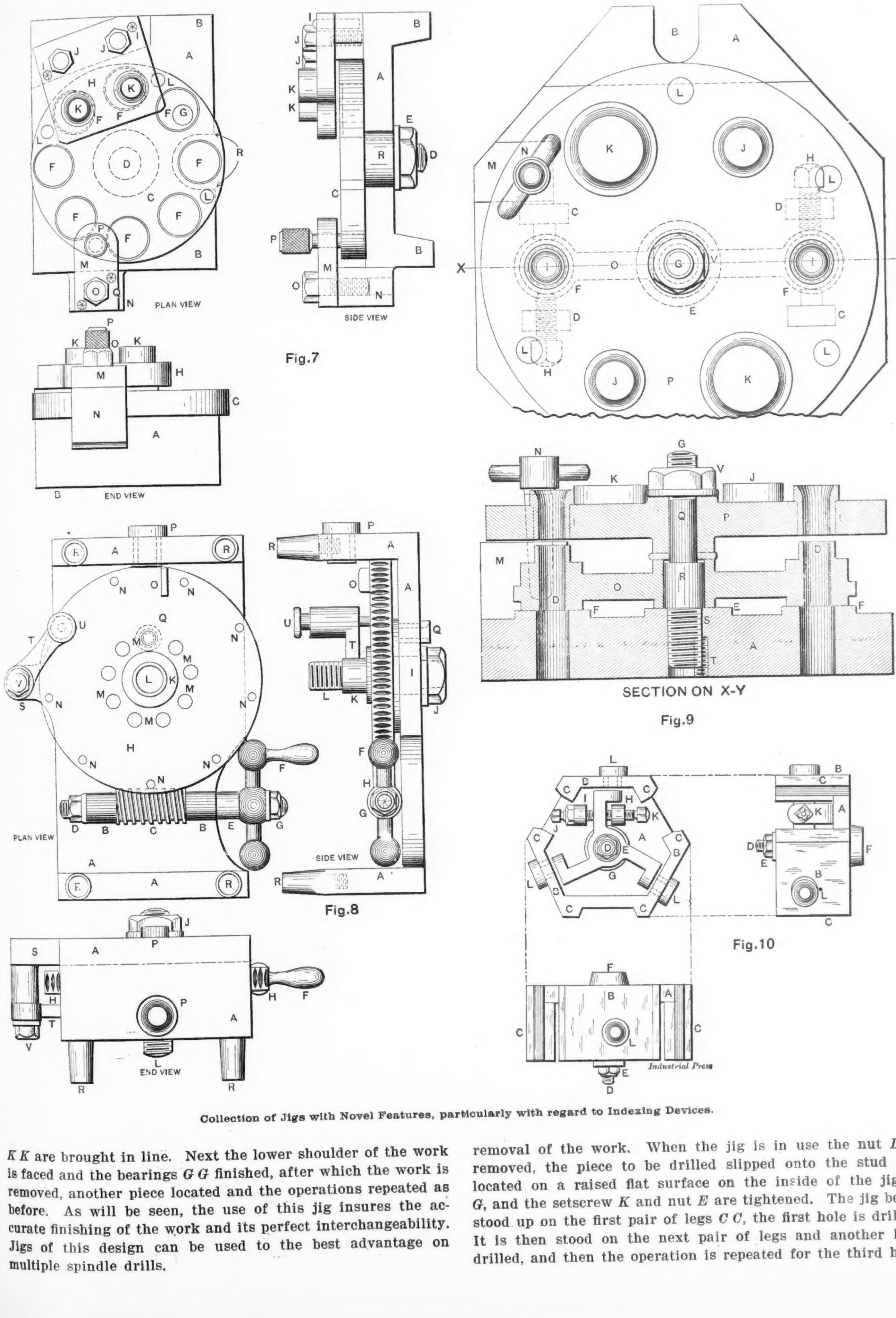
In Fig. 9 we have the other adaptation of the dial principle, as used for the finishing of work in a manner entirely different from any before shown. The piece machined in this jig is shown in Fig. 5. It is a drop forging of the shape shown. It is machined at three points on the back at *A A A* on a milling fixture, the center hole *B* is bored and reamed to size, and the top *C* is faced in a special chuck in the turret lathe. The remaining operations necessary to finish the piece are all accomplished by the use of the jig shown in plan and cross-sectional view in Fig. 9; i. e., the drilling of the hole *D*, Fig. 5, in the center of each end, the facing of the top; the finishing of the parts *E* by a hollow mill; the facing of the wide surface or shoulders *F*, and the finishing of the half-round bearings *G G*. As this jig (Fig. 9) is of a novel and special design a detailed description of the practical points necessary to its successful construction is essential. The body or base of the jig is of cast iron, with a slot *B* at either end for clamping it to the drill-press table. The three raised surfaces *E* and *F F* locate the work. The lugs *C C* are the side locating points, and those at *D D* are for the setscrews *H H*. Base *A* is first planed on the bottom, and the projections are finished to the height shown. It is now strapped on the lathe faceplate, and bored and threaded for the central locating and fastening stud, which is of tool steel turned and finished to the shape shown. This stud is threaded at *S* to screw tightly into base *A*, and at *R* to fit the center hole in the work *O*, and is reduced for the rest of its length to the size shown at *Q*, and finally the end *G* is threaded for the nut *V*. The locating points *C C* are finished so that when the work *O* is forced against them by the setscrews *H H* it will be in the position shown in the plan view of Fig. 9. The dial or bushing plate *P* is of cast iron, finished all over and bored and reamed in the center to fit snugly the locating stud *Q*. The holes for the six bushings *I I*, *K K*, and *J J*, are located and finished to the size required on the lathe faceplate, care being taken to get the centers of all six on the radius required, and to space them accurately. Next the bushings are made, hardened, ground, and lapped to size, and driven into their respective holes in the plate *P*.

Before locating the six indexing holes *L* one of the forgings, Fig. 5, was laid out and strapped on the lathe faceplate and the hole *D* at either end bored and reamed to size. This forging was then fastened within the jig, Fig. 9, and used for locating the first index hole in the following manner: Two steel plugs were turned to size, to fit the bushings *I I*, and the holes *D D*, in the work. By inserting these plugs through the bushings the bushing plate *P* was accurately located and held rigidly in position. The first index hole was now drilled through the plate *P* and into the projection *M* of the base *A*. Next the hole was reamed with a taper reamer until the taper locating or index pin *N* entered to the depth shown by the dotted lines in the cross-section, Fig. 9. Bushing plate *P* was then removed, and the five remaining index holes *L* located and reamed to size on the dividing head of the universal milling machine. All the parts were assembled as shown in the two views in Fig. 9, and the jig was complete and ready for work.

For use the jig is bolted on the table of an adjustable multiple spindle drill, and two of the spindles set so that the drills will enter the bushings *I I*. The arms of the

drill press are adjusted to bring the spindles into proper line and are then clamped. The holes $D\,D$ in the work, Fig. 5, are drilled, then the drills are removed, the nut V loosened and the bushing plate P is revolved one space. Index pin N is now re-entered and nut V tightened, which brings the facing bushings $J\,J$ in line with the work. The top being then faced, the plate is revolved one space and the bushings $K\,K$ are brought in line. Next the lower shoulder of the work is faced and the bearings $G\,G$ finished, after which the work is removed, another piece located and the operations repeated as before. As will be seen, the use of this jig insures the accurate finishing of the work and its perfect interchangeability. Jigs of this design can be used to the best advantage on multiple spindle drills.

Fig. 10 shows three views of a jig that is self-explanatory, and is merely illustrated to show how the drilling of a number of holes in a piece at a given angle to each other may be accurately accomplished in jigs of the simplest construction. The work, Fig. 4, is fastened within the jig on the stud D, as shown in Fig. 10, and located against the adjustable screw I by setscrew K which allows of the rapid locating and removal of the work. When the jig is in use the nut D is removed, the piece to be drilled slipped onto the stud and located on a raised flat surface on the inside of the jig at G, and the setscrew K and nut E are tightened. The jig being stood up on the first pair of legs $C\,C$, the first hole is drilled. It is then stood on the next pair of legs and another hole drilled, and then the operation is repeated for the third hole.



Collection of Jigs with Novel Features, particularly with regard to Indexing Devices.

LETTERS UPON PRACTICAL SUBJECTS.

NOTES ON TAPS AND CUTTING MULTIPLE THREADS.

Editor MACHINERY:

The three twist-fluted taps, shown on page 249 of April MACHINERY, remind me of having used similar ones to tap nuts by hand in a small shop at Kokomo, Ind., in 1861. The labor required to twist such taps through a few dozen ⅞ nuts has been an excellent aid to my memory. Some time in August of that year, Mr. J. G. Butterfield, afterwards master mechanic of the St. Paul and Sioux City R. R., gave me a "spell" by tapping a few that were left, himself. The last nut split when the tap was about half-way through, which meant forging another one. We made them by punching a lot of holes in a flat bar, then cutting the bar off between the holes and squaring the pieces up. Three or four ⅞ nuts could be made at a heat. I saw "J. G." mop the sweat from his features which wore the peculiar expression they always did just previous to his "tapping his barrel of words." I knew something was coming, so went over to hear, hoping he would smash the tap by way of emphasis. But he didn't; he just fired a Philippic at the tap that would have immortalized him, had it been printable. In one of his invectives against it he called it a "nut buster," a name so appropriate that it helped very materially to scrap the whole lot of them. New straight flute taps were then made by W. R. Michener, at that time proprietor of the shop, and, so far as I know, he was the first to "relieve" them. This he did by upsetting the teeth before tempering, as shown in Fig. 1. I do not remember the kind of thread his taps cut, but they ran much easier, and would have been an efficient perspiration economizer had not the number of nuts to be tapped increased with the general demand for

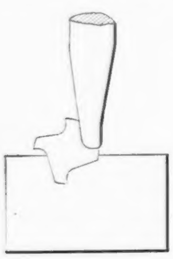


Fig. 1.

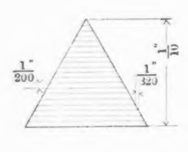


Fig. 2

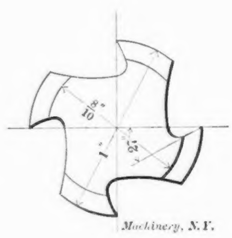


Fig. 3.

nearly everything at that time. They were soon after tapped in a lathe by putting the tap on the centers and holding the nut with a wrench. That was my first lathe work.

There is a big difference between the cutting conditions of a drill and a tap. The drill takes everything before it, the tap must leave about one-half the stock.. The drill has one cutting edge to each flute, the tap has three; if it is a twist drill the cutting edge has a lip, giving it a chance to cut, while the tap has to punch the stock off, because the flute is not usually made so the teeth can cut. Just why taps should be so far behind drills in this respect is an enigma.

To illustrate some points in this connection, I have made Figs. 2 and 3, the latter being an end view of a taper, four-fluted, eight-thread, one-inch tap. The first five threads are tapered; the balance cut straight. It is clear that all the stock must be removed by the five threads at the point, and as there are four flutes, there will be twenty cutting teeth. Assuming the thread to be one-tenth of an inch deep, the amount to be cut by each tooth will be 1-200". The horizontal lines in Fig. 2 show the successive cuts by the twenty teeth, to form the space; the side cut is 1-320" deep, as marked on the figure. With a hooked flute, as in Fig. 3, the length of the side cut is slightly increased, but 80 per cent of the stock is removed by the top of the teeth, and there is where the thin edge counts.

From the above it will be seen that a twist-fluted tap will give a longer top surface to the threads, and while it may give the leading side a better cutting edge, the opposite side will be at a disadvantage; hence, it is safe to say that the more twist given to the flute the harder it will be to twist the tap. If some one will make a tap that will do nearly all the cutting on the leading side, as Mr. John T. Giddings uses thread tools in the lathe (described in April MACHINERY, page 256), he will have an ideally perfect running tap. I think Mr. Giddings will find it to be an advantage if he uses them to rough out only, to give them side, instead of top rake.

There are so many ways of cutting multiple threads on a lathe that are easier than the way Mr. McAlpine suggests in April MACHINERY that I will call attention to them. If a double thread twice the pitch of the leadscrew is to be cut, catch every other thread on the leadscrew by noting

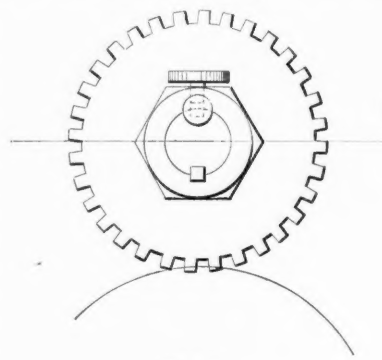


Fig. 4.

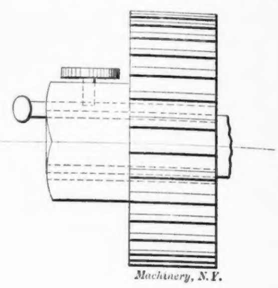


Fig. 5.

the time to throw in the nut; or one thread may be cut, and then the tool set midway between the two threads, and the other one cut, if the pitch of leadscrew is not applicable. Probably a better way than the last one, is to have the spindle pinions cut with as many keyways as the number of multiples to be cut. Figs. 4 and 5 show this way: Cut one thread, then pull out the key and turn the faceplate till the key will fit in the other seat, then put it in and cut the next thread. The wheel is free to move on the spindle, when the key is out.

Equally spaced drivers on the faceplate, or slots to drive from, using a driver for each thread, is about as easy a way, and possibly more accurate, than the one just described. The best thing of the kind I ever saw was made by a latheman who took a lot of gate valve stems to make by the job. He found that by taking alternate cuts, first on one thread then on the other, he could rough out much quicker than by cutting one thread at a time, as this weakened the stem for the second thread. What he wanted was a dog, or a pair of drivers that "would and wouldn't" drive, as the case required. The pros and cons of each were discussed, and the result favored the dog, which is shown in Fig. 6. The tail

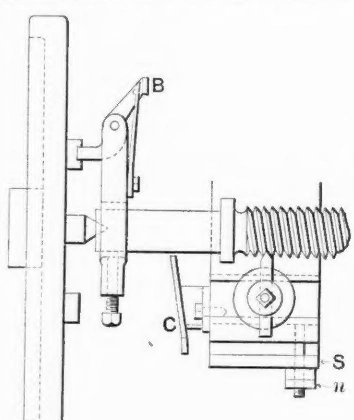


Fig. 6.

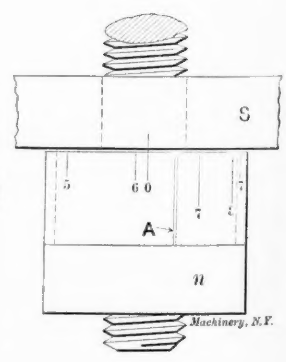


Fig. 7.

is split and a latch put in and held in position by the spring. When the tool gets up to the end of the thread the projection marked *B* strikes the incline *C* and releases the dog from the driver. Just at that time the operator pulls the tool back and opens the nut on the leadscrew, and a spring attached to the carriage brings it back to the starting place against a stop; then when the chalk marks on the faceplate and leadscrew correspond the nut is closed and the tool run in for another cut.

Unless something happened the lathe was not stopped from start to finish of a screw.

In order to always give the tool the best depth of cut, he made a graduated stop-nut, shown in an enlarged view, Fig. 7. This consisted only of a deep nut, turned down on one end to receive a piece of tubing, split at *A* so it would go on the nut with just enough tension to keep it from turning too easily. It was then spaced off for the right number, and also to give each cut the proper depth. To illustrate, the tool was run up till its point just touched a blank stem that was ready to thread, then the nut was screwed against the stop *S* and held there while the sleeve was turned around on the nut till its zero-line corresponded with the datum-line on the stop, as shown in Fig. 7. Now the nut was turned till line *I* coincided with the line on the stop, then the tool was run in till the nut struck the stop, and so on till the thread was finished.

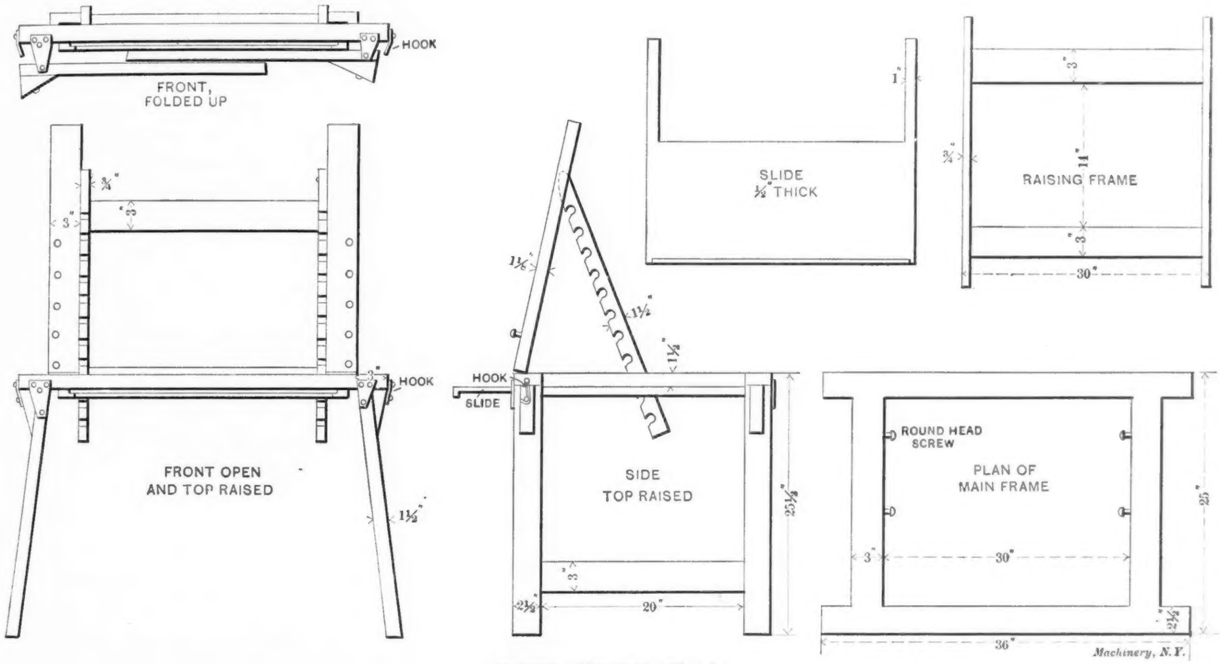
Youngstown, Ohio. J. H. Dunbar.

* * *

AN ADJUSTABLE FOLDING DRAWING STAND.

Editor Machinery:

In these days of correspondence schools a drawing-board stand that can be folded up and put one side is almost a necessity in the small rooms of many of the students. I send blue print of one I have lately made that is more convenient than any I have seen before. It is made to take a 23" x 31" board or larger, but can be made smaller if desired. The top is adjustable to any angle from horizontal to vertical, and can be adjusted from 26" to 38" from the lower edge of the board to the floor when in vertical position. The slide shelf underneath can be drawn out to hold instruments, etc. The hooks on each leg hold them firmly, so there can be no falling down. The space underneath is all open for foot room when sitting at the stand. In most folding stands the crossbraces underneath are very much in the way. The stand is made of pine, the joints are doweled instead of being mortised, and the hinges for the legs are of sheet brass.



Details of Drawing Stand.

Pinon, Colo. S. M. Preston.

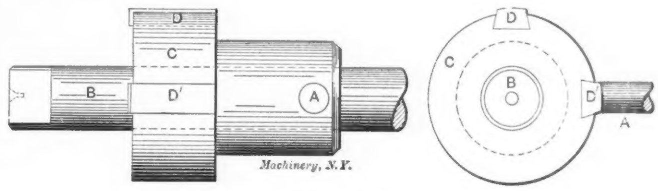
* * *

A HANDY TOOL.

Editor Machinery:

There was at one time a tool in quite general use which, on account of the simplicity of its construction and its effectiveness, was considered a valuable adjunct to lathe chuck work. Strange to say, it is seldom seen now, and, prompted by curiosity, inquiries were made regarding it, but it was found that few had ever seen or heard of it. It is well worth mention on account of its merits, and may prove a great help to some, though, of course, it will be recognized by many. But for those who are not familiar with it, the accompanying cut and explanation are given:

As will be seen in the cut, the tool consists of an arbor, *B*, straight and true, with centers hardened, and a cast iron head *C* fitted to slide freely, yet without play, on same. Two cutters *D D'* are inserted in the position shown, projecting a little beyond the edge of the head. These are dove-tailed in place. They can be arranged other ways to suit. The head should be made about ¼" less than the diameter of the hole to be bored. The cutters are put in and turned to the size required. *D* should be brought down to allow *D'* to take



A Boring Tool.

the finish chip. *D* takes the roughing chip, and is slightly in advance of *D'* but under the full size. The operation consists of placing the work in the chuck and the boring bar on the centers. Care should be taken to see that there is no danger of running into the chuck jaws. A pin about ¾" should be fitted in the hole at *A* to keep the head from turning round. This pin rests on the tool-post block. A tool is put butt end into the tool-post, so as to bring up against the end of the hub or head as it will be understood that the carriage feeds the tool along.

This tool is very effective in boring castings of, say, 5" diameter and up, and, of course, not of too great a depth of hole. It will soon pay for itself where there are a number of pieces to be bored. No dimensions are given, as it is made to suit the work.

S. Wrench.

* * *

AN OLD-TIME MACHINIST.

Editor Machinery:

There is an old man working in the shop where I am employed who is a relic of the "old time." He is nearly eighty years of age, and has worked at the trade for more than sixty years. At the vise he can work "all around" the young men, and at the lathe is all right with hand tools; but when it comes to getting the work out of the machines he is "not in it." On the planer he will use a diamond point tool that is ground with side rake to cut either way. He cannot grind a twist drill. He does not like to see the work hurried, and when some of the young fellows turn out work faster than they used to he gets out of humor. He is an adept at "soldiering." He works upstairs, and one day he had a piece of ½-inch round iron that was too long. Instead of cutting it off in his lathe or at his vise, he went down to the shears in the

blacksmith shop, then to the emery wheel at the other end of the building, during which he walked nearly a block. He brought a casting downstairs and got the boy to drill a hole for him, carried it upstairs again; then he came down and borrowed a tap, took that up and tapped his casting for a setscrew. Finally he made the third trip down for a setscrew. Of course, he has more liberty than a young man. He learned his trade in the old country, and, judging from his talk, that is the way they all did in his time.

WABASH.

* * *

RECEIVING TOOLS.

Editor MACHINERY:

The tools described below have been in use for a number of years. They are employed in the manufacture of guns, typewriters and other articles that require small drop forgings of irregular shape which cannot easily be machined, but which must be interchangeable.

We will assume that a piece is to be made like that shown in Fig. 3. After it has been forged or filed nearly to size the piece is driven through the aperture in a hardened steel die or former shown in Fig. 1, or if it cannot be driven clear through it is alternately filed and driven into the die until the true size and shape have been obtained.

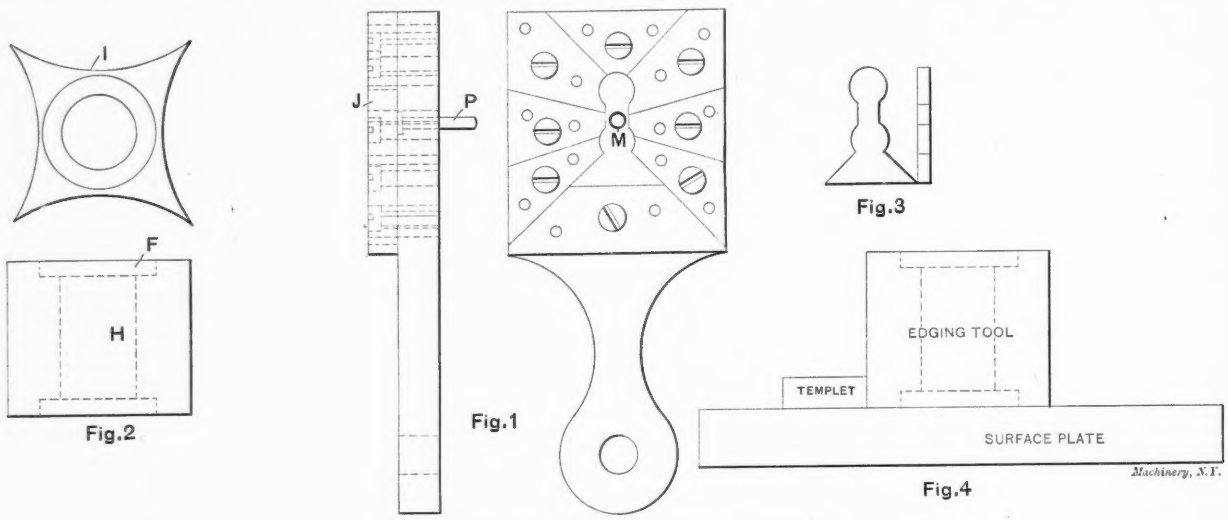
In making the tool the bottom plate, which usually consists of a piece ½" thick, is first finished and is provided with a handle for convenience. The part comprising the former or die is made up of several pieces of tool steel fastened to the plate by screws and dowel pins. This makes a more durable construction than a die composed of one piece, which would not withstand the hammer blows to which it must be subjected. The number of sections depends upon the size of forging to be finished and also its thickness. After laying out the sections in the desired shape, extending them toward the center of the plate so that the opening left at the center will be smaller than the templet in Fig. 3, they must be filed and scraped so that they will fit nicely at the joints.

Fig. 2 shows an edging tool that can be used to advantage in scraping the edges of the sections. In Fig. 4 is shown the method of using the edging tool. In making this tool the hole *H*, Fig 2, is first bored and reamed, and then chambered at both ends, as shown at *F*. This is done to produce a bearing on the outside edges. The edges are then faced square with the hole, and the piece is milled to the shape shown at *I* in Fig. 2, the edges being kept as sharp as possible. After hardening, the edges are ground on a B. & S. surface grinding machine, and after stoning the edges to remove all roughness the tool is ready for use.

Returning now to the fitting of the section pieces, this should be commenced by taking one section and finishing both edges; these sections having been milled, or planed in a strip, and fastened to the plate with screws and dowels. After the sections have been filed a surface plate is brought into use, Fig. 4. The section piece being finished with its top and bottom sides parallel is laid flat on the plate and its sides are scraped with an edge tool, the tool being exactly square. Since the tool rests on the surface plate its edge must be square with the plate, and will scrape the edge of the section piece perfectly square with its two sides. In this way it is possible to make good joints between the different sections.

Having all the section pieces fastened to the plate, if the fitting is done in a workman-like manner no points will be left open. The templet, Fig. 3, must now be accurately shaped and hardened. It is placed on the face of the plate *J*, Fig. 1, and with a sharp awl a line is scratched around the periphery. Each section piece is taken off separately and filed, and finally finished with the edging tool. This operation is continued until all the plates are completed, and if done correctly the exact shape of Fig. 3 will be formed in the section pieces placed on top of the plate. Having these all fitted, they are marked in rotation and taken off to be hardened, the bottom plate being hardened also. At the center of the bottom plate, at *M*, a hole is drilled and counterbored and a pin is turned with a head to fit the same. This is used to drive out pieces when being fitted, and I am sorry to say this pin played an important part a great many times, for many men do more driving than filing.

The templet or masterpiece should be retained by the foreman of the tool room and the receiver sent to the department where the work is to be done. The drop forgings are roughed out nearly to size, then placed on top of the plate and struck with a hammer which leaves an impression. The forging is then driven out and filed as near the line as possible, and again driven into the receiver, or as far as possible. It is then finished with a fine file and driven again. If the filer, as he is commonly called, is a first-class man, this will complete the work of finishing the pieces.



Receiving Tool—Its Design and Method of Construction.

Providence, R. I. A. NOTROH.

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SOME USES OF THE PATTERN-SHOP LATHE.

Editor MACHINERY:

The percentage of useless work done on lathe jobs is often out of all proportion to the total time that should be used in doing them. Some descriptions of a few quick methods may prove interesting.

I screw work directly to the iron faceplates, thus saving the time and material for making a wood addition to the iron one. The work does not stand out so far and enables a heavier cut to be taken, as it is held more rigidly. I use a wood faceplate only to get some special diameter; or when I want to glue the work to the faceplate. This is necessary for some light work, as very often there is not room for screws. If a machinist can chuck a piece true by adjusting it, why cannot a patternmaker? Of course, the means of adjusting are in favor of the machinist, but still it is quite possible, as well as practical, for the patternmaker to do this. In work that requires rechucking, I turn a line on the work the same diameter as the faceplate, screw the faceplate to the

line as near as possible, with two screws only, put it in the lathe and center it. Then I take it off and put in more screws. I consider this far quicker than turning a chuck to fit the piece to be rechucked.

By using a faceplate smaller than the work, even though it is necessary to build out with a row of segments to the required diameter, the entire piece can often be turned without rechucking. If the screw in the screw chuck runs true, work can be rechucked by turning a hole in the outer end of the piece of the size for the screw in the chuck, and then screwing to the chuck by this hole. It will nearly always run true enough for all practical purposes.

In turning numbers of small parts on a screw chuck I put on a long piece and cut the parts off, using the tailstock until the piece is cut down short enough to be rigid. This does not require the lathe to be stopped for each piece, consequently saving a good proportion of time. On work where much stock is to be removed, use a thin cutting-off tool; cut in from the face of the work, and again on the diameter of the work to meet the first cut, thus cutting off a ring. Or, where a piece requires an angle cut it off with the cutting-off tool. This is far quicker than reducing the waste stock to shavings.

I recently had a flywheel in the lathe that we were in a hurry for, when another hurry job came in. This was a ring somewhat smaller than the rim of the flywheel. Having two floor rests but only one lathe heavy enough for either job, we chucked the ring on the arms of the flywheel and two men worked on the one lathe. While each job could have been done in less time had but one man at a time used the lathe, we got the work out in time to please both customers. While one man was roughing out his work the other tried to take his finishing cut as much as he could. This was necessary, as the belt was scarcely heavy enough to pull while both men were doing the roughing.

There are many other such methods, applicable only to some one job, that will save time, material and labor.

Denver, Colo. J. L. Gard.

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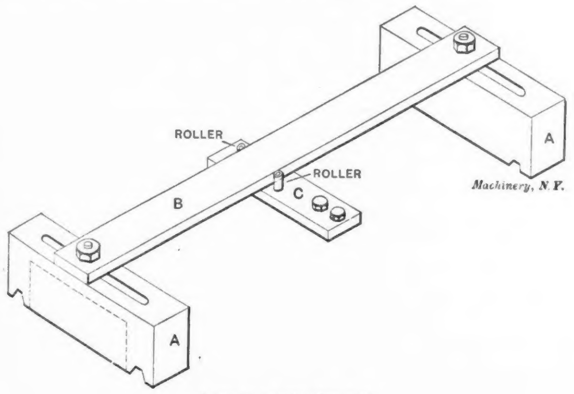
A TAPER ATTACHMENT.

Editor Machinery:

We desired to fit up one of the lathes in our shop with an arrangement for boring taper holes, the same to be used occasionally for taper turning. The lathe was an ordinary 42-inch engine lathe, somewhat ancient, but in good order. The sketch shows how we solved the difficulty.



A Taper Attachment.

The two pieces *A A* were made of cast iron planed to fit the V-ways of the lathe in question. They were of box pattern cored as shown by the dotted lines, and were 6 inches high by 4 inches wide. The top had a slot cored out 1 inch wide for a ⅞-inch bolt. We made the piece *B* of mild steel planed straight on the bottom with parallel sides and two holes drilled in it, two inches from each end. The piece *C* was drilled and tapped for two studs; each stud has a turned roller on it. The rollers were just far enough apart to allow the piece *B* to slide freely between them with as little play as possible. The other end of *C* was drilled for two bolts previously turned to fit tightly in the holes in the crossfeed slider, where the screws which held the crossfeed nut in place usually were. The pieces *B* and *C* were made of 1" x 4" material, *B* was 4 feet long and *C* about 12 inches. Two clamps were made of the same material, slotted like the top of the cast iron pieces *A A* and long enough to clamp under the ways of the lathe by means of two ⅞" bolts (not shown) through each piece *A*, which were so placed as to clear the piece *B*.

We took the screws out of the crossfeed nut, ran the nut to the back of the lathe—which left the cross slider free—and then bolted the piece *C* to the slider, as previously explained. The bolts being a tight fit, held it rigidly. We then laid *B* across *A A* as shown, setting it to the required taper by measuring at each end, getting as close as we could, which is usually close enough, as the one-inch holes in *B* will allow enough variation to finish setting *B* without loosening the bolts in *A A*.

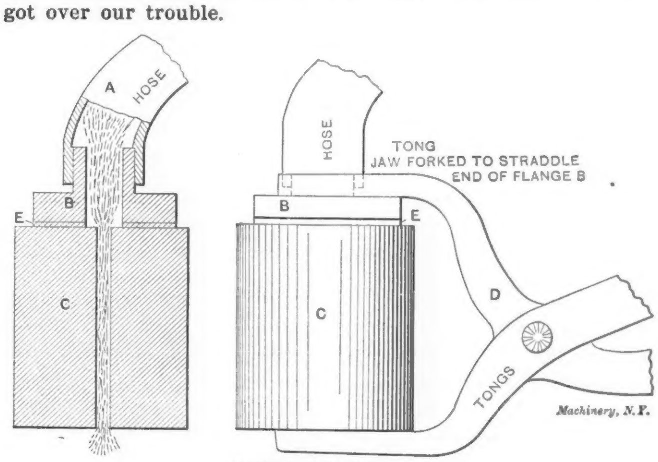
To operate, tighten the bolts in *B*, take a cut and try; if not correct, loosen one end of *B* and adjust by tapping with a piece of wood or any soft material in the direction required and try again. This outfit is in pretty constant use principally for taper boring, and it can be set quite as quickly as the average taper attachment. For standard tapers like the Morse or Brown & Sharpe, it has holes drilled through *B* into *A A* for taper pins which locate *B* at once for the given taper. Care must be taken, however, to get the apparatus on the lathe the same way each time. We use the compound rest for setting the tool to its cut. E. J. H.

* * *

HOW SOME ROUND DIES WERE HARDENED.

Editor Machinery:

We had some trouble in hardening round dies. They would contract in the center, and the ends would be large and the center small—as much as 5-1000 inch. The holes in the dies varied from ⅛ to 5-16 inch. The sketch will show how we got over our trouble.



Method of Hardening.

B is a cast iron flange; *A* is a hose attached to *B* for running the water through the die; *E* is an asbestos joint to keep the water from coming in contact with the outside of the die; *C* is the die, and *D* is the tongs for holding the cast iron flange to the die. Now, in hardening the die the water only comes in contact with the center of the die, so the center is hard and the outside of the die is soft, and, in drawing the temper the hole remains straight. The die is held with the tongs over the trough and salt water is used.

Reading, Pa. J. D. W.

* * *

RECOLLECTIONS OF A COUNTRY JOB SHOP.

Editor Machinery:

I learned my trade in a country job shop, and I have been thinking that some of the boys who don't have the good fortune (?) to serve their time in a shop of that kind would be interested in hearing about it. It was one of those Simon-pure jobbing shops; nothing that came in at the door was turned away. In fact, if it could not be got in at the door, we took it just the same. I well remember the two weeks I spent out of doors in the front yard, ratchet-drilling sugar kettles that were so large that they would not go through the doorway, and much less under the drill press, even if we had got them into the shop. It was not a bad shop to work in, only one learned lots of things that don't come in the machinist's trade nowadays.

There were four of us in the shop besides the boss—two

journeymen, an older apprentice and myself. My duties consisted principally in going to the foundry and blacksmith shop, oiling up, lacing belts, swinging the sledge, and sweeping; with, now and then, a lot of mill bolts to cut with a jam plate. I used to call it another name, but it won't look well in print.

I used to get many queer jobs to do. I remember once that the boss took a contract to turn out a lot of fence posts, to be 5 inches at the top and 7 inches at the butt. Do our best, we could not find a farmer who could tell how large the post must be to finish up 7 inches at the butt; finally, I went into the woods and calipered the trees, marking those that were to be cut. There were, if I remember correctly, some 100 or 200 posts, and I turned the greater number of them.

We did not lack for variety of work in the old shop; it would run from cider mill screws to carpet sweepers, and from saw mills to sewing machines; with, now and then, a boiler or water-wheel. All was grist that came to the mill, and it was always ground, too. Some of it might not have passed a navy inspector, but it worked, and that was what our customers wanted.

I well remember a saw-mill job that came in one day. It was four spiders to be bored out and setscrewed. They were 7 feet in diameter, with a 3 15-16 hole. I thought the "old man" was stuck when I saw them come in. The largest lathe we had was a 24-inch, blocked up to 36-inch. The "old man" did not get stuck, however, but I did, for I had it to do. He had me take the headstock off the 24-inch lathe and turn it around so that the faceplate hung off the end of the bed, and then strap the spider on the plate. We had a milling machine (not a B. & S.) with a long slide. This was blocked up so that the slide stood at right angles to the faceplate; then a long boring tool was clamped in the vise, and I was ready to go ahead. They were bored out, ratchet-drilled for the setscrews and drilled around the edge to hold on the lagging. The lagging was put on after they were put in place in the mill, and then they were turned off with a wood tool, making a wide, flat pulley.

Well, I got the job done, and then I was sent down to the mill to help put them on. It was away off in the woods, five miles from nowhere. We got there all right, and the mill-owner and myself put them in place. One of them was too small; it was not up to me, for the holes were to size, but the shaft was a 1-32 larger up next the wheel pit. I got it within two feet of where it should go, but could get it no further. But the mill-owner helped me out; he got a lot of oil and emery and covered the shaft, then put a rail through the spider, started the wheel, and ground out the hole; it stuck on us when it was within six inches of the place where we wanted it, and we let it go. It took us quite a while to do this, but it was a great deal better than filing. The mill man was well pleased with the job, and said that if he had any other he would send it our way.

We used to have a good many engine repairs, and one day we were getting a portable engine off the truck and into the yard. It was a job that had just come in, and we had it on the blocking, when a peddler came along. He stopped his team and watched us a while; then got down from the wagon and stood around for a short time; then he began to help pile blocking. Pretty soon he forgot he was not one of the gang and began to give off orders. The "old man" stood it a few minutes, then sang out, "Hold up!" and turning to the fellow said, "Say, when did you hire out, and who put you in charge of the job?" The fellow gave us all one look, pulled himself together, jumped into his team and drove off. A better instance of a man's forgetting his place I never saw.

There was one thing in the shop that I had to put up with, from which the boys of to day are exempt—i. e., rough, practical jokes. Many a time I have had the back of the shipper handle daubed with slush so that when I went to start the lathe I would find it "all right." All of the lathes but one had slow-moving tight and loose pulleys, and a favorite trick was to set a pint grease cup on top of the tight pulley so that when you started the lathe, you would get it "in the neck." The blacksmith shop was a terror. One day I was sent down in a hurry to get some tools dressed. The smith was out, but the two boys were there, and what did they do but tie me, hand and foot, put me down the "wheel hole," put the cover on, and keep me there a half-hour; then when I got back to the shop I got "Jesse" because I was gone so long. I was country bred and didn't lack grit, but it was two to one, and into the hole I had to go.

The ruling wages paid apprentices at that shop was seventy-three cents per day, and to pay $4 per week for board, as I had to do, did not leave much with which to paint the town red. As good luck would have it, I had been making good wages for a year before in a shoe shop, and had a few clothes, so I stood it a year very well, but I remember carrying a two-cent piece until it was worn smooth, so that I could say I had some money left. The boss was a good man, and took care to give me a show when he had a chance to do so, which, however, was not often. But I learned many things there that have come in handy since—such as forging a lathe tool, making a wood or metal pattern, doing a good job of piping, swinging a sledge, and firing up and running an engine; and, as the boy said, "it doesn't cost anything to carry it round."

A. P. Press.

* * *

WRINKLES IN THREAD CUTTING.

Editor Machinery:

I have had men try to explain to me how to cut threads in a lathe by throwing out the half nut and running the carriage back by hand. They would have rules for marking the headstock and faceplate and hand wheel and gears with chalk, and if you did not forget the combination your tool went in the right place. But somehow, I was always in too great a hurry to follow those various mysterious ways to a termination when I had threads to cut.

The use of a scale on the ways is very useful if a chip does not catch between it and the apron, and that used to be my favorite method; but now the boys do it differently. They do not use the method on very short threads, however, as they can run back as quickly by power; or on fractional threads, as it takes too much space to find a stopping point. The first time I saw the method used I thought I had a lot of spoiled work on hand, and I have seen many another man not acquainted with this way of doing think likewise. I have also had two men work side by side and have a man habitually use the method without the other one "catching on."

Suppose you have to cut 9 threads to the inch, which is one that the ordinary leadscrew on a medium-sized lathe does not divide right; we will assume it is about 4 inches long. Run the first cut over in the usual manner; throw out at the end, run the carriage back and throw the nut in as soon as the tool clears the end of the thread. Do not throw the tool into the cut, but after it has run up enough to be over the thread a little, stop the lathe and see if the tool will match the thread. If it does not, open the nut, move back one thread and try. If it still does not match, go back another thread. When it does match, note how far back you moved to make it match; then start up the lathe and run up to the end. Throw out and run back, and this time try to throw in as far from the end of the thread as the distance you went back to make the tool match the thread, then throw in and see if it matches. If not, ascertain whether you went back too far or not far enough, then try again. If the pieces you are to thread are all of one length, stop at the end—at the place you find right to throw in—and move the tailstock up so it will be against the carriage, to act as a stop to run back to. This helps a novice, but is looked upon as an unnecessary refinement by the expert.

The most important point in using this wrinkle is the art of taking out the nut and tool and running back at the same rate of speed; but a little practice gives confidence in this. I do not know how common this practice may be in some parts of the country, but I know that it is generally unknown to new men who come to work for us, and they require considerable "showing" before they can take hold of it. Yet it is a time saver and will often cut the time in two. It will work on 11½ pipe threads when the thread is not over 1½ inches long, as that will give time enough to get back; but the novice had better first practice on even

threads, and the use of a coarse leadscrew makes it much easier.

In connection with threads, there is another little wrinkle not as well known as it should be. Where a man is producing threads of a uniform fit and wants to do it with the least expenditure of force, he must not use a pair of calipers with points dressed to a sharp edge so as to get down to the bottom of the thread. These are good enough for finding the diameter of the bottom of the thread, but no good for a fit. If the man who has always used that kind of calipers for thread cutting will take a pair of calipers whose points will only go about half-way down the side of the threads and go over a lot he has cut, I think he will find out something and be tempted to take himself to task for not having made the discovery before. I was foolish enough to offer the first man I saw using that kind of caliper for thread cutting the use of my fine-pointed ones, thinking he was without a pair. He said he didn't need them; I guess he didn't. A minute's thought will show why.

Ordinary threads are not made to bear on the point, but an ordinary thread tool has a trick of wearing off there much faster than anywhere else.

I suppose it is unnecessary to say that for people who make perfect threads these things may be of no interest, as their threads would measure the same at all places; but most threads are not "perfectly" perfect in this section.

If you want a practical illustration on expansion take a cold die and cut some threads on cold stock some day. The poorer the oil and the harder you crowd the machine the plainer the illustration and the more taper the threads, with the big part at the point. If the dies are dull it will not lessen the taper but may surprise you if you lay a scale on the threads and measure the pitch. Indeed, some of the young men might be surprised if they tried it on a thread 10 or 12 inches long, cut with a sharp die.

Did you ever try to run a long setscrew into a hole and find it gets tighter the farther in it goes? Well, the next time it occurs lay the threads of the tap and the setscrew together and then try to think of a way to make perfect hardened setscrews at a reasonable cost.

Other people are trying to do the same thing and some succeed better than others. W. OSBORNE.

* * *

ELECTRICALLY-DRIVEN LATHE CENTER GRINDER.

Editor MACHINERY:

This grinder, originally designed for grinding centers of lathes, has proven very useful in many ways, and its flexibility has solved many problems in grinding, in the shop in which it is used, that would otherwise have required special fixtures and much expense. It is so arranged that inside and outside grinding, within the limits of the device, may be done with one chucking, or any angle in the plane of the base may be readily obtained. Its range is not limited to a lathe, but may be easily attached to most machines in which work is turned or milled.

The grinding spindle is driven by an ordinary electric fan motor wound to receive the incandescent light circuit, and its nominal power is supposed to be 1-6 horse power. The motor is shunt-wound, however, and its real power is believed to be about 1/4 horse. The speed of the motor is such that, with a 3 1/2-inch pulley on the armature shaft and a 1-inch pulley on the spindle, a grinding speed of 4,700 revolutions per minute is obtained. For small internal grinding a higher speed may be gotten by putting a larger wheel on the armature shaft, and the slotted hole in the bracket *G* allows for adjustment of belt.

The largest emery wheel used to date is 3 inches in diameter, but the spindle is sufficiently rigid to carry a larger wheel. The spindle bearings are cone-shaped, hardened, ground and lapped with adjustment for wear. The spindle is hardened and ground and has a taper hole in one end to receive arbors. The other end is threaded to receive the screw that holds the loose rawhide washer for feeding the spindle. The lateral movement of the spindle is 2 1/2 inches, and it may be firmly clamped in any position by the thumb nut *Y*, Fig. 2. The base *A* receives the rocker *B*, to which it is pivoted at *C*, and is clamped to the arms of *A* at *D*. This arrangement permits a vertical adjustment of the spindle exceeding 1/2 inch, and allows for the alignment of work and tool when grinding at an angle. The rocker *B* receives the swivel table *E*, and is bolted securely by a central stud. The base of *E* is circular and is graduated to 360 degrees. The long boss *F* is easily reached for clamping after the table is set to the required angle. Two long arms are cast on *E* to carry the bearings of the spindle at one end; at the other end the bracket *G* is pivoted. A wing *H* is also cast on the base, the slot having the arc of the radius *I K*. The bracket *G* carries the motor, and as before stated allows adjustment of belt.

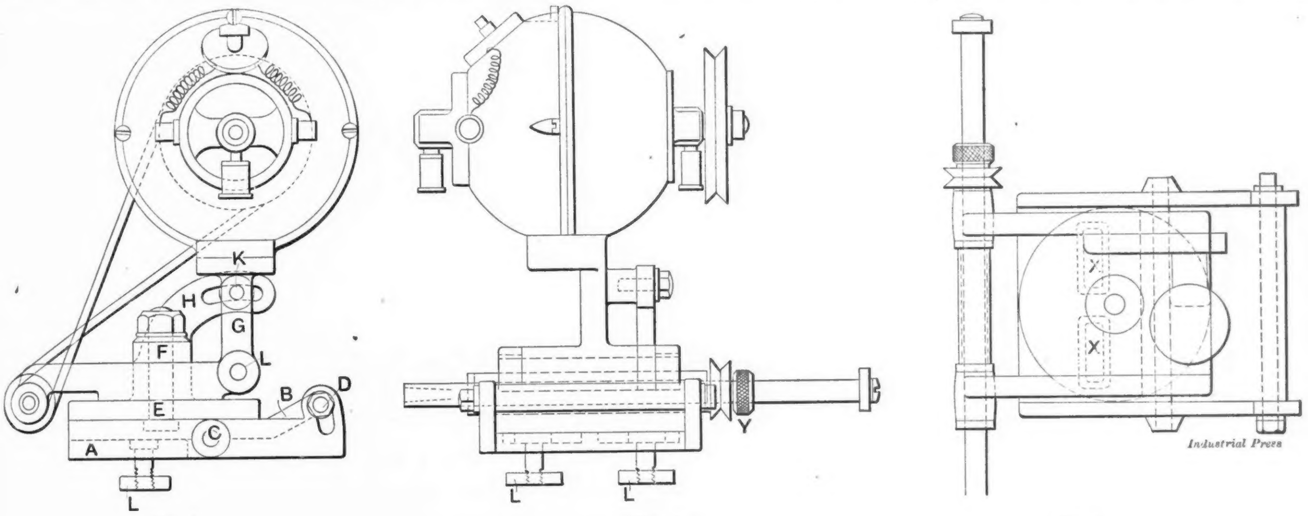


Fig. 1. Fig. 2. Fig. 3.
Electrically Driven Center Grinder.

The whole device is fastened to the machine by the nuts *L L*, Fig. 2, the screws of which are adjustable in the slots *X X*, Fig. 3.

Brooklyn, N. Y. J. R. GORDON.

* * *

GROOVING TWIST DRILLS ON A PLAIN MILLING MACHINE.

Editor MACHINERY:

I send you herewith sketches and description of a method of milling the grooves in twist drills, counterbores, etc., on a hand miller or plain milling machine. Very fair twist drills may be made by this method, and the time taken to do them on a hand miller will compare favorably with the time required to do the same pieces on a universal milling machine.

An ordinary pair of index centers is clamped to the table or held in the vise, as shown in Fig. 1, at an angle to the table, or slide, of the machine. The proper angle at which to set the centers is determined by laying out the right-angled triangle, *A B C*, Fig. 3, in which *C* equals the length of the circumference of the piece to be milled, and *A* equals the distance endways of the work taken by the spiral in making one complete turn. The angle *E* is the angle at which to set the centers. If the angle is determined upon, instead of the dis-

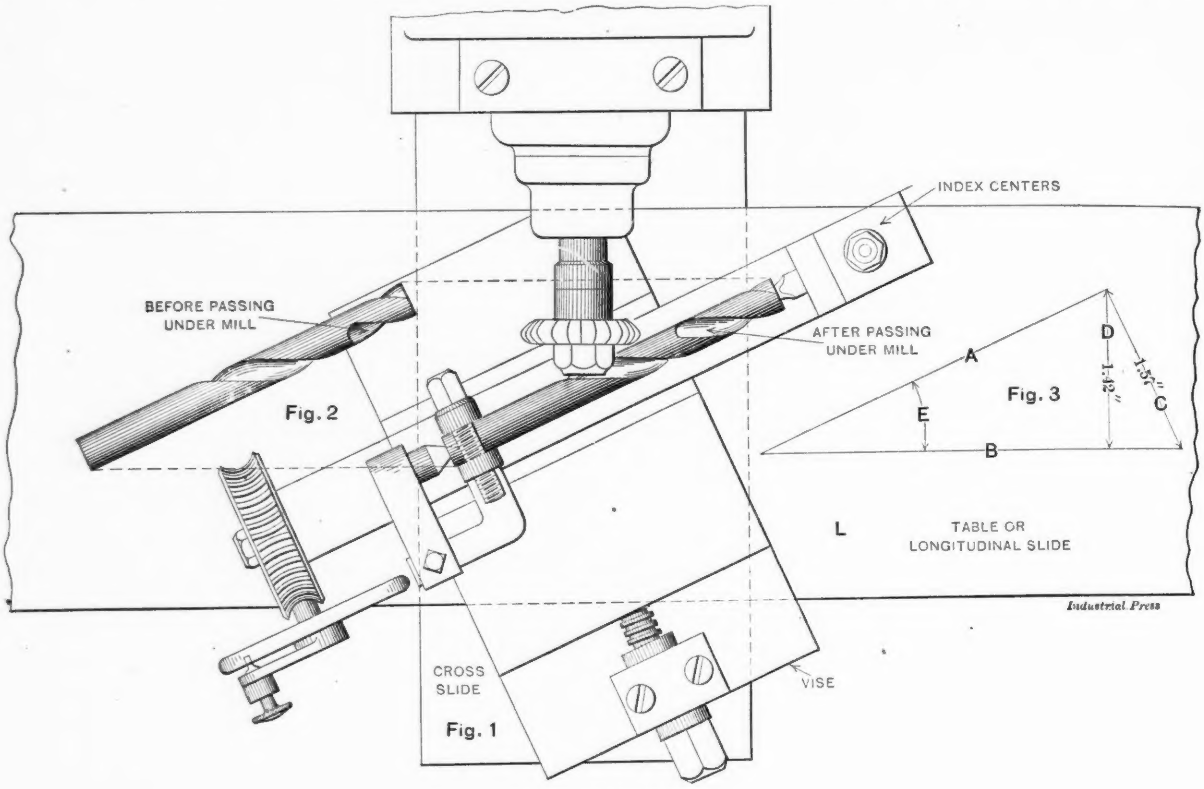
tance of one turn of the spiral, the centers may be set properly at once without laying out a triangle as above.

The work is set central with the mill and also to the proper depth. The piece to be operated upon is passed under the mill, taking a cut across the work at an angle with it. It is then run back and indexed around slightly. Before passing the work under the mill a second time, the cross slide of the machine will have to be moved a little to match up with the cut previously taken and which is thrown out of line by indexing the work. The following order of operations is kept up: Passing under the mill and returning; indexing, and then moving the centers parallel with the spindle to match up the cut; then passing under mill, etc., as far as may be desired—which makes a spiral longer or shorter, dependant upon the angle at which the centers are set. One or more parallel flutes may be cut, as desired.

Where there are a number of pieces to be cut, it will pay to rig up a little to obviate the necessity of matching up the cuts by the eye. The exact amount to move the cross slide may be easily determined as follows: Having laid out the triangle as previously described, measure the distance *D* measured at right angles to line *B*. This is the distance that the cross slide will have to be moved to one revolution of the work, or the spiral making one turn. This distance is to be divided up into as many parts as the number of indexings to one revolution of work. Suppose we wish to make a twist drill ½ inch diameter, and have the flutes at an angle of 27 degrees, the angle of common twist drills. Figure the circumference, which is 1.57 inches. Make a right-angled triangle with a short side 1.57 inches long and 27 degrees at *E*. Meassuing distance *D*, it is found to be 1.42 inches. If an ordinary pair of centers is being used, which requires 40 turns of the worm to make one revolution of the work, and it is intended to index half a turn of worm at a time, then 1.42 inches will have to be divided into 80 parts, which is about .018 inch. If the cross slide screw is 6 threads per inch, then one turn of it would move the cross slide .1666 inch, and .1666 divided by .0178 equals 9.35, which is about 9 1-3. If the cross slide screw was turned 1/9 1-3 turn at each indexing, it would be near enough to what is wanted in this case. Multiplying 9 1-3 by 3 equals 28; then 3-28 turn of screw equals the same as 1/9 1-3 division, and is more convenient.

In cutting more than one flute or groove on a piece, I start the cuts at the end of the piece on each groove; then after finishing a groove the proper starting point for the next groove is easy to set to. This is a much easier and simpler job than would appear from the description.

Meriden, Conn. JAMES P. HAYES.



Grooving Twist Drills.

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TAP DRILL SIZES.

Editor MACHINERY:

In the table of United States standard screw threads published in the data sheet issued with the March number of MACHINERY, I note that you allow a clearance of one-eighth the height of the original thread angle in obtaining the column of tap drill sizes. I think this might mislead some mechanics who might find that their work would not pass inspection if they used tap drills so much larger than the actual diameter at the root of the thread of the screw. Such threads would not pass inspection for government work, and I think not for general work.

I enclose a table of tap drill sizes for U. S. standard threads which I formulated in 1882, and while it is not perfect it gives satisfaction for nuts, bolts and screws and is now used constantly. If your readers will examine it carefully and report any changes that they would suggest to make it better I should like to have them. The second column headed "Set Vernier" applies to readings of screw-thread calipers having one anvil grooved at an angle of 60 degrees to fit over a thread on one

Screw Threads, United States Standard.

Diameter of Bolt	Set Vernier.	No. of Threads per inch.	Hole in Nut.	
			Exact Size.	Drilling Size.
¼ inch.	.2175	20	.1850	.188
5/16 "	.2764	18	.2403	.244
⅜ "	.3344	16	.2938	.298
7/16 "	.3911	14	.3447	.349
½ "	.4500	13	.4001	.405
9/16 "	.5083	12	.4542	.459
⅝ "	.5659	11	.5069	.512
11/16 "	6284	11	.5694	.575
¾ "	.6850	10	.6201	.626
⅞ "	.8028	9	.7306	.737
1 "	.9188	8	.8376	.844
1⅛ "	1.0322	7	.9394	.947
1¼ "	1.1572	7	1.0644	1.072
1⅜ "	1.2667	6	1.1585	1.167
1½ "	1 3917	6	1.2835	1.292
1⅝ "	1.5059	5½	1.3888	1.398
1¾ "	1.6201	5	1.4902	1 500
1⅞ "	1 7451	5	1.6152	1.625
2 "	1.8556	4½	1.7113	1.722
2¼ "	2.1056	4½	1.9613	1.972
2½ "	2.3376	4	2.1752	2.186
2¾ "	2.5876	4	2.4252	2.436
3 "	2.8144	3½	2 6288	2.640

side of a screw and with the other anvil pointed to fit between the threads on the opposite side of the screw.

Providence. G. E. WHITEHEAD, Supt. R. I. Tool Co.

[The table published in the data sheet referred to was calculated with the idea of giving tap drill sizes such as would be used by the average machinist in ordinary shop work. Our experience is that a machinist will generally use a tap drill of larger diameter than the sizes specified in most tap-drill tables. While imperfect threads are the result, the practice does not seriously weaken the thread and it makes it easier to tap the hole and fit the screw. On the other hand, it is desirable to have the thread in a nut as nearly perfect as possible, and we are glad to publish a table giving sizes as near to the theoretical ones as an extended trial has found to be feasible to use.—EDITOR.]

* * *

MACHINING A STEEL CRANK DISK.

Editor MACHINERY:

Permit me to submit to you the following method of finishing a cast steel crank disk from the rough casting.

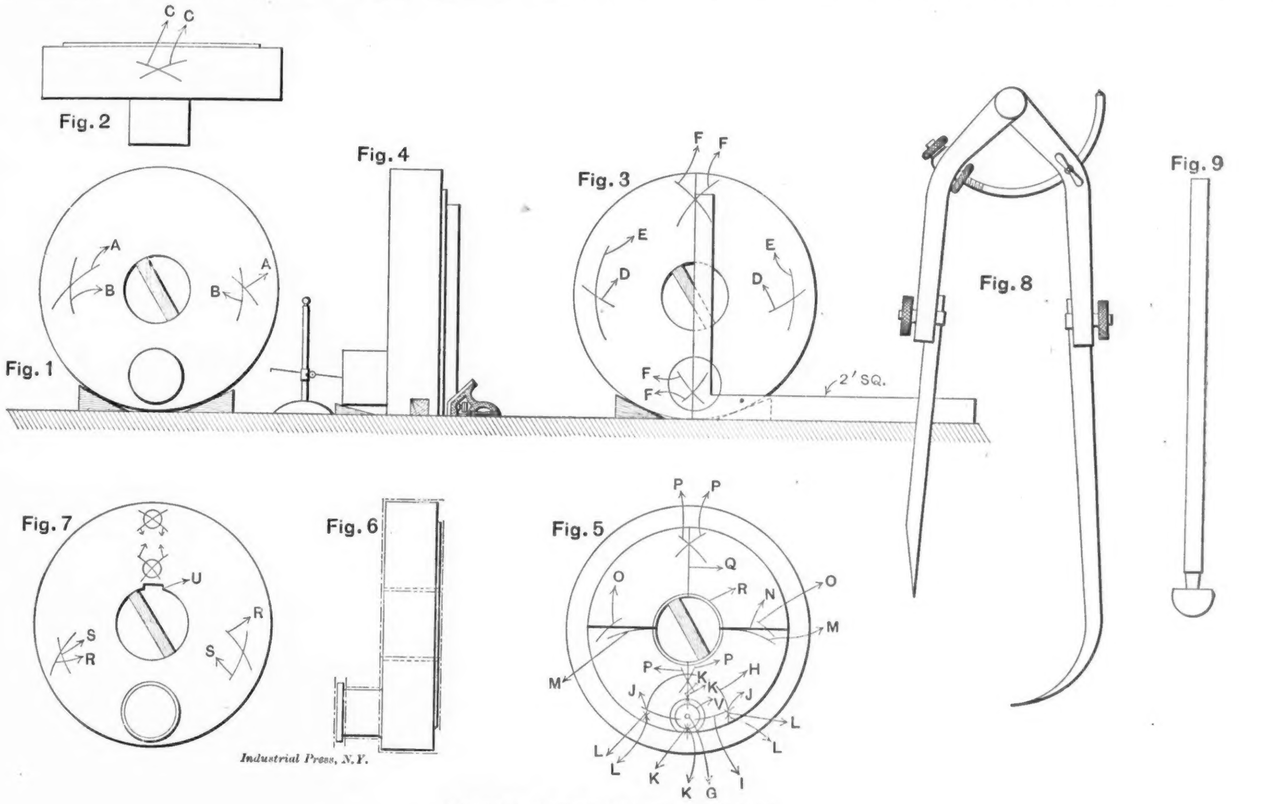
First, paint the casting, using whiting mixed with water and applied with a brush. When it is dry find the center of the crankpin, as shown in Fig. 1, then place the center stick in the crankshaft hole. Take three wooden wedges for use in squaring up the casting, Fig. 4; then find the center of the disk on the stick, Fig. 1, for use as a center. Strike arcs *A A* from the center of the crankpin with dividers. Now strike arcs *B B* and make light prick punch marks at the points where these arcs cross. Using these as centers, strike arcs *C C* on top of the disk, Fig. 2, with the dividers shown in Fig. 8, by placing the crooked leg in the prick punch holes. Then with a surface gage the center of the crank pin should be carried around to the other side. Now scratch arcs with the dividers from where arcs *C C* cross, giving arcs *D D*, shown in Fig. 3. From the center of the disk on this side strike arcs *E E*, and where these arcs cross use as centers for obtaining arcs *F F F F*. Now with a square, shown in Fig. 3, draw a vertical line through the intersection of these last arcs, and where the line cuts the horizontal line previously scratched with the surface gage will be the center of the crank pin at the back of the disk. With small dividers lay out circles for centering on the pin and the disk. After these are centered under the drill, finish the crankpin and the face of the disk as in Fig. 6. Be sure to leave enough stock on the opposite side to finish.

This being done, lay out the crankshaft hole for boring on the rough side. Again find the center of the crank disk on the stick, Fig. 5, and use this as a center. Take out the crooked leg from the dividers and replace it with a ball divider leg. Now strike arc *H*, using dividers with the ball at center *G*. Strike arc *I*, cutting arc *H* at *J J*. Again with dividers strike circle *V*. From *J J* as centers, strike arcs *K K K K*, cutting circle *V*, and from these points as centers strike arcs *L L L L*; finally from these points as centers, strike arcs *M M* with a radius equal to the distance from the center of the disk to the center of the pin. Also from the center *G*, strike arcs *O O* and make prick punch marks where they cross line *N*, drawn tangent to the two arcs *M M*. Strike arcs on the stick, which is the center of the hole desired. Now lay out a hole for boring *R*.

By means of parallels wide enough to clear the crankpin, strap the disk against the faceplate, true up with the circle and bore the hole. The reasons for boring the hole from this side is because it is liable to be more or less tapering and will thus press better on the shaft.

After the hole is bored, drive on to the arbor, turn and face up and finish the lines indicated by the dash and dotted line. Next lay out a keyway and get the center on the stick from the hole. Strike arcs *S S*, Fig. 7, with a ball divider, from the center of the crank pin. Strike arcs *R R*, and from where these cross as centers strike the arcs shown near the top of the disk. From their intersections strike circles equal to the diameter of the keyway. With a rule tangent to these circles draw a keyway *U* the depth desired. After this is splined, it is ready for the hydraulic press.

Holyoke, Mass. C. W. PUTNAM.



Method of Laying Out the Crank Disk.

* * *

The sebaceous glands at the side of the nose of the human species secrete a small quantity of excellent lubricant. A knowledge of this physiological fact is sometimes utilized by slick salesmen of shears and scissors to make them work smoothly when being exhibited to a prospective customer. If the shears work roughly owing to a slightly tight joint or rough cutting edges, the salesman casually rubs his forefinger alongside his nose and then along the shear blades. The effect is magical; the shears then work as smoothly as could be desired. As the change has apparently taken place without anything being done to the shears, the customer, satisfied that his objection was based on a fancied defect, usually buys them and departs without ever knowing how nicely he has been fooled.

AUTOMATIC SCREW MACHINE WITH NOVEL FEATURES.

The principal distinguishing feature of the Spencer automatic screw machine is the use of cam-wheels and cam-disks on which are bolted flat strips at certain angles and in alternate reverse positions so that the cam rollers engaging them are given alternate movements parallel to the axis of the cam-wheel or at right angles to it. The movement of the rollers is communicated to the turret slide, the cross slide and the wire feed mechanism. The sequence of the various cams and their angles and arrangement is determined by the character of the work to be made. The forming of a stud or screw will be found to require certain definite operations which, to be expeditiously performed, should follow in a certain order without long pauses or intervals between them. Tools which necessarily operate while traveling parallel to the axis of the work are mounted on the turret slide and those which operate at right angles to the work are usually mounted on the cross slides. The cams for the turret movements and for the cross-slide movements should be adjusted to bring the different tools into operation as quickly as mechanical consideration will allow. After bringing a tool into proper position, its movement must be accommodated to the limitations of the work and the character of the stock. The setting up of a screw machine for any work is known as "camming."

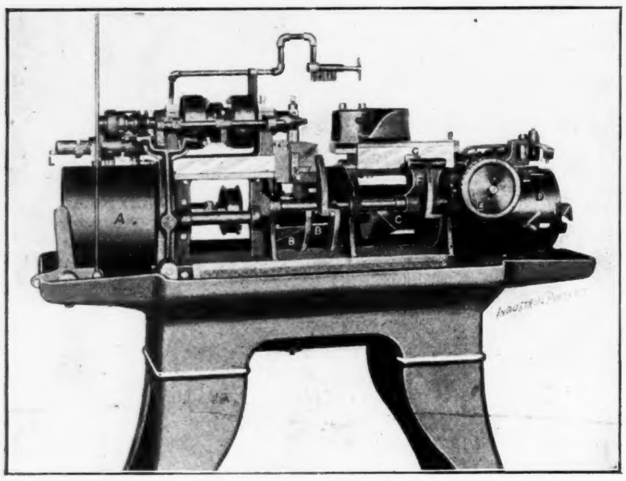


Fig. 1. Sittman & Pitt Screw Machine.

To cam a screw machine so that all events will occur correctly and within the least possible time is a feat requiring skill of no mean order and which is only acquired after considerable experience. Even with the services of an expert it often occurs that after a machine has been set to work it will be found that there is loss of time between certain movements which could be avoided in the original camming, but to correct which will necessitate re-camming the machine. To do this means extra expense and the loss of the product of the machine for the time required and the consequence is that if the defect is not too radical, the machine is put to work under more or less inefficient conditions.

These faults of the ordinary screw machine as demonstrated by their own shop practice, have caused the firm of Sittman & Pitt, State Street and Boerum Place, Brooklyn, N. Y., to design the screw machine shown in the accompanying cuts. The feature of this new machine is the use of special cams for operating the tool slides, which have a peculiar contour and which are universal for work within the range of the machine. This means that the camming of a machine for any particular job is a matter of adjustment of permanent parts. If the first adjustment proves to be not quite satisfactory, the readjustment is merely a matter of loosening nuts and making the required change.

The principle involved in the shape of the cam is illustrated in Figs. 2 and 3, which show two sides of the turret operating cam. From inspection of the cuts it will be seen that the cam may be resolved into two principal parts: A cylinder *F* and a solid, the outer contour of which in any cross-section is an Archimedes spiral, as *A E*, Fig. 2, and which as a whole is an irregular warped surface. The shape of the cross-section of this portion of the cam changes in the length of the cylinder so that the cross-section shown at the opposite end in Fig. 3, is as indicated by *G J H*. The cam may be considered as being made up of an infinite number of thin cams placed side by side, but of varying contour. *A B* and *G J* (the lift of the cam) are equal, but it is evident that the cylinder circumference, *J H* at the end shown in Fig. 3, is much shorter than *B E*, the portion of the circumference embraced as shown in Fig. 2. Therefore the angular distance passed over

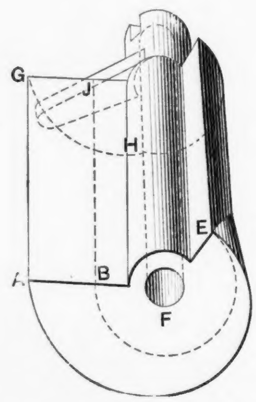


Fig. 2.

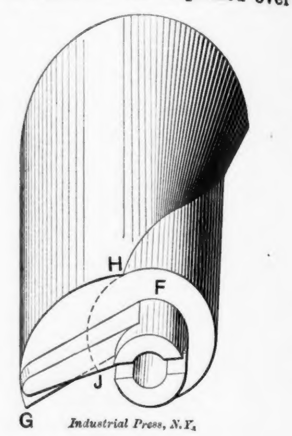


Fig. 3.

by the rotation of the cam to give the full throw to a lever bearing on it, would be dependent on the longitudinal position occupied by the bearing toe. At the end shown in Fig. 2 an angular movement of about 240 degrees would be required while at the other end an angular movement of only about 80 degrees would be necessary. The device is thus a variable speed cam inasmuch that although it rotates at a uniform velocity during the time of tool action, the time and velocity of the movement of the actuated lever depend on its longitudinal position. This position is adjustable and is changed for each individual movement of the operating tool to get the proper speed.

Referring to Fig. 1, the turret operating cam is shown at *C* and the cross slide operating cams at *B B*. *A* is an ordinary cam-wheel for operating the wire-feed mechanism. *D* is a cam-wheel for determining the longitudinal position of the operating levers for the turret and cross slide. The position of the adjustable cams on the cam-wheel *D* determines the position of the turret-operating lever *H*, Fig. 4, along the cam *C*. *H* is the lever which moves the turret up to the work and feeds it along, and *F* is the retracting lever for returning it. As the retraction of the turret is always done at a fixed rate, this lever is operated by a cam of fixed contour and is not longitudinally adjusted. The cross slide is

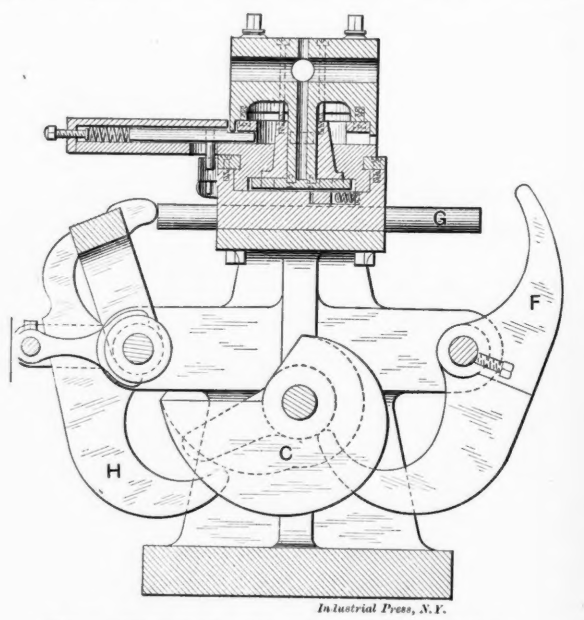


Fig. 4. Cross Section through Turret Slide and Cam.

operated by the two cams *B B*, one for each direction of movement, and each has its working face of a variable contour the same as the turret cam.

The turret is operated from the levers *H* and *F* in a novel manner. A rack of circular section *G* is moved across the turret slide. The connection between this rack and the levers being one of contact only, the levers are free to slide over it as required by their longitudinal travel and are provided with broad faces for this purpose. The movement of the rack is transmitted to a pinion under the turret slide, which in turn transmits it to a longitudinal rack attached to the turret slide, thus changing the direction of movement through 90 degrees.

The camming of the machine for any piece of work is the adjustment of the cams on the cam-wheel *D*, of which there are two sets, and those on the cam wheel *A*. One set on *D* is adjustable longitudinally for the levers operating the turret slide and the other circumferentially along the edge of the rim for the fast and slow speed of the cam shaft. The cams on *A* are for feeding the stock and for reversing the direction of spindle rotation. The cams for feeding require no adjustment, the adjustment for feeding the stock being effected by the screw *L* which limits the throw of the feed lever. If the screw allows the full retraction of the lever the stock is fed the full limit of the feed mechanism. If the screw is adjusted to the other limit, there is no feed at all. The adjustment for feed may be made while the machine is running. The cams for reversing the spindle are circumferentially adjustable along the inner edge of the rim of the cam-wheel. It is apparent from the foregoing that the setting up of this machine is the adjustment of permanent parts and that there is no drilling and tapping of holes or the shaping of cams to any particular contour. This is a feature of prime importance in the economical operation of screw machines and marks a decided step in advance in their development.

* * *

METHOD OF MACHINING LATHE BEDS.

The Automatic Machine Co., Greenfield, Mass., manufacturers of automatic screw machines, speed lathes and cutter and reamer grinders have recently built and installed in their factory a combined milling and boring mill which possesses a number of features of interest. The machine was designed with special reference to the work done in the shops of this company, and the illustrations show it set up for operating upon speed lathe castings.

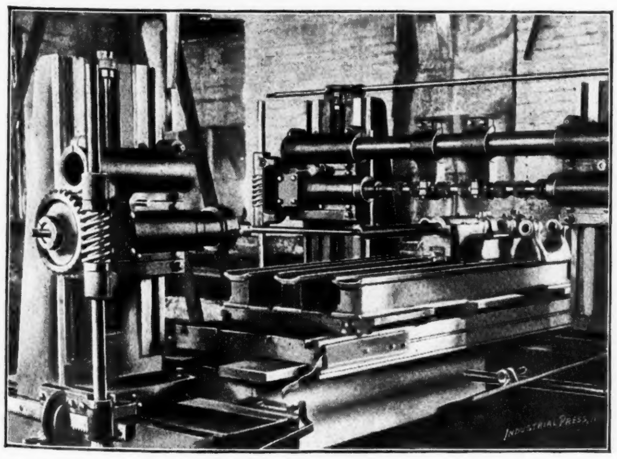


Fig. 2. Boring the Lathe Headstocks.

These lathes are made with the headstock and bed in one casting and the milling and boring machine is adapted for machining these at low cost, and also so accurately that the castings will be interchangeable and the lathe spindles will align with the ways without an excessive amount of scraping. The lathe beds are first placed upon a jig, as represented in Fig. 1, it having a capacity for three 11 inches by 5 feet beds at the same time. Three beds are milled on the bottom and on one side, all at one cut. They are next placed upon another jig, as shown in Fig. 2. The ways are milled as shown in the illustration. The mills are raised and the lathe heads are milled for the caps. They are drilled and tapped by a radial drill not shown in the engraving. The boring jig is next placed in position, and the heads are bored for the boxes. In this manner each lathe must be exactly like every other lathe, and consequently all parts will interchange.

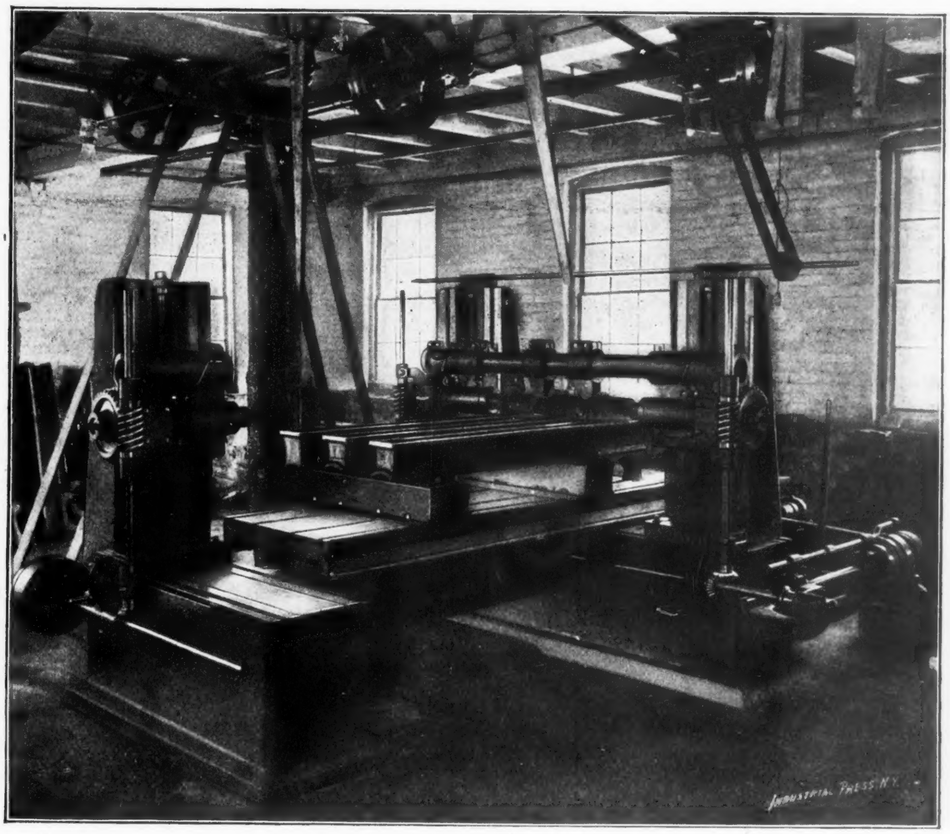


Fig. 1. Milling and Boring Machine arranged for Milling Lathe Beds.

This method of doing the work is found to be a great step in advance of those formerly used. It enables the manufacturers to turn out the work in large lots at low cost, and the product is found to be as nearly perfect as could be desired.

* * *

A London electrical firm, Sherard Cowper-Cowles & Co., have made some experiments in sharpening worn-out files by dissolving electrolytically a thin film of the surface metal thus leaving the angles sharp as when new. This process has not proven very successful in the past, but this firm announce that they secured quite satisfactory results with an electrolyte of ferric chloride and a high-tension electric current.

* * *

One of the curiosities of the hardware trade is a magazine tack hammer. The magazine is located underneath the handle and holds 60 or 70 6-ounce or 8-ounce tacks. Each tack is fed to the magnetized face of the hammer by pressing a trigger which releases one tack and locates it in the proper position on the hammer face. The novelty of the device is said to be only surpassed by its convenience.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

In addition to the tools listed under this heading an automatic screw machine has recently been brought out by Sittman & Pitt, Brooklyn, N. Y., and is illustrated in another part of this paper.

In the January, 1900, number of MACHINERY, the Simplex Center Grinder, made by Herman Dock, Philadelphia, Pa., was illustrated and described. It consisted of a very compact attachment for clamping in place of the tool holder, which carried an emery wheel for grinding the center and the proper gearing for same, the driving wheel of the gear being driven from the face plate direct. An improvement of this grinder has recently been brought out, known as the Simplex Universal, which has the advantage of a positive drive, and in which centers of other angles than 60° may be ground. It is adjustable so as to grind centers of angles from 55° to 90°, and the first part of the drive is a gear and pinion, the latter with teeth at an angle of 16°, which replaces the former round belt. An adjustable equalizing driving rod is now used to engage in the face plate in opposite points, so as to absolutely balance the pull of the lathe and prevent variations in the speed of the emery wheel.

The Hoggson & Pettis Mfg. Co., New Haven, Conn., have brought out a self-opening and adjustable screw cutting die head. The die is composed of four chasers, arranged to be adjustable to different diameters and to open free from the work after any desired length of thread has been cut. The dies, or chasers, are inclosed in rectangular slots formed by the head and the cap, and are backed by the outer shell, making them very rigid. The shell which backs the dies has a cam cut in it at the back of each die, so that by loosening two nuts at the back of the head, the dies may be adjusted very closely or slacked off to cut threads fitting either tight or loose, or to compensate for any slight wear. When this head is used on an automatic turret machine, the feed is arranged to be thrown out when the desired length of thread is cut, at which the pressure of the stock on the dies draws the head forward, causing the dies to open by springing back into beveled recesses in the shell and thus immediately clear the work. The dies are interchangeable, so that dies of any thread number, either standard or special, may be substituted. The use of chasers allows chips and dirt to easily clear the work and, as the head is hollow throughout, oil may be forced through to keep the dies clear.

AUTOMATIC SCREW MACHINE WITH NEW FEATURES.

The annexed cuts, Figs. 1 and 2, show front and back views of a new automatic screw machine recently placed on the market by the Automatic Machine Company, Greenfield, Mass. The machine contains a number of interesting features which are believed to make it a decided step in advance in the evolution of the automatic machine. One belt suffices for driving both forward and backing spindle pulleys and also operating the feed mechanism. The belt arrangement favors grouping a lot of machines closely together as they may readily set at an angular position and thus overlap so as to get a greater number in the length of a room.

By making the feed drive dependent on the main belt there is no danger of wrecking the machine by the breaking of a driving belt and the consequent running away of the feed motion as sometimes occurs with independent feed motion. The manner in which one belt is made to fulfil its triple function is plainly shown in the engravings. The belt is wrapped around a pulley set at an angle which thus acts as an idler to reverse the belt for the forward and backing pulleys and also transmits motion to the feed mechanism. In Fig. 2 the shaft on which the idler pulley is mounted is shown carrying two bevel gears, the upper one of which meshes with a gear case and the lower with another bevel gear mounted on a universally-jointed shaft carrying a slitting saw. The gear case contains an epicyclic gear train which is arranged to accelerate the motion of the various tools when bringing them into position.

The principal feature of the new machine and the one which will be most appreciated by those having experience with the older types, is the ease with which it is "cammed" for various classes of work. Instead of using the flat-faced drums requiring the use of strap cams bolted to their faces,

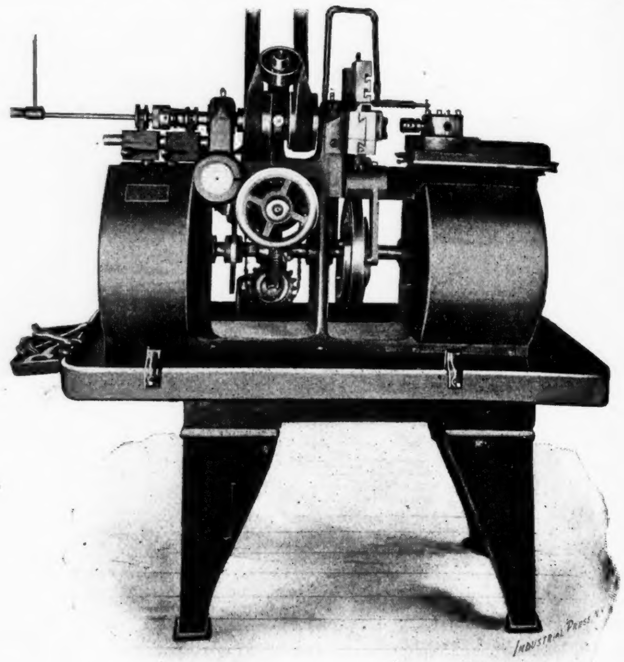


Fig. 1. Front View of Automatic Screw Machine.

the method has been adopted by which the cams are held to the cam-wheel by T-bolts engaged in continuous T-slots around the periphery of the wheel. With a variety of cams of various angles provided, the camming of the machine for any job within its capacity is a job of minutes compared with one of hours where the straps have to be laid out and holes drilled and tapped by the old method.

There are three cross slides, two horizontal and one vertical. The slides are attached to the headstock which makes them more rigid in resisting the cut and also saves space

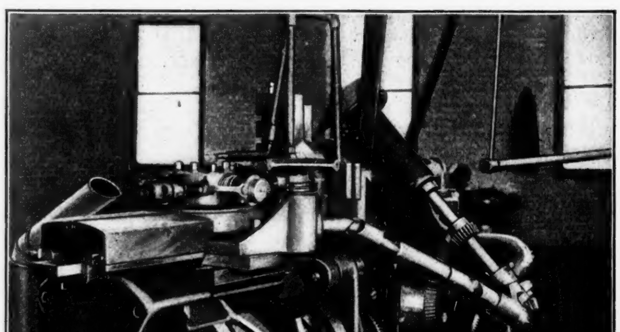


Fig. 2. Back View of Automatic Screw Machine.

in the length of the machine, doing away with excessive overhang of the turret tools. The cross slides are mounted in vertical instead of horizontal planes, which tends to make them more durable as dirt and chips cannot as readily work into the joints and ruin the sliding surfaces. They are operated by the cam-wheel shown underneath the center of the machine. It carries adjustable cams, secured by T-bolts in T-slots, as is apparent from Fig. 2.

The entire feed mechanism is engaged or released by a clutch on the handwheel shown in front of the machine

below the driving pulleys, Fig. 1. By the use of this clutch the operator can stop or start the feed while the machine is in motion. By releasing the clutch, the feed mechanism may be moved forward or backward by the handwheel. The automatic wire feed is controlled by hand levers conveniently located. The dogs operating the friction clutches work easily and without concussion.

The turret can be entirely removed by releasing one screw. It is provided with four holes and has a positive stop. The indexing can be made independently for any desired combination of tools, that is, it is not necessary for the turret to move forward and backward for each hole in the turret, but it may indexed for two, three or four holes, as the work may require. Two tools may be used as expeditiously as four, as no time is lost in unnecessary movements. Another important feature is that the finished screw after being slotted by the slitting saw is deposited into a separate receptacle from the chips and oil.

The machine having a chuck capacity of ½ inch weighs complete about 1,500 pounds. The legs are cast in pairs, one pair of which is rigidly screwed to the bed and the other pair is mounted on a rocking shaft which thus does away with any danger of springing the bed when set on uneven floors.

PLANER MILLING ATTACHMENT.

The Adams Co., Dubuque, Ia., have brought out a new design of the Farwell milling attachment for use on iron planers. In Fig. 3 is shown the attachment in a vertical position in use with an inserted-tool cutter for surfacing. A special countershaft is furnished for driving the planer at

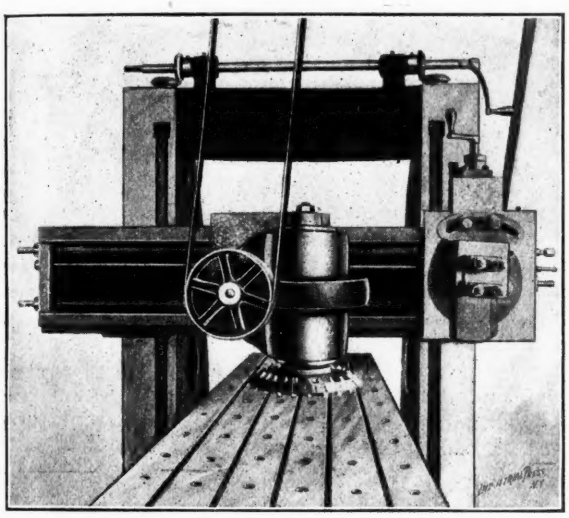


Fig. 3. Milling Attachment in Vertical Position.

a speed suitable for feeding against a milling cutter. The spindle may be used in a horizontal position by swivelling the head through 90 degrees and attaching a cutter arbor in place of the cutter, the free end of which arbor is supported by a bracket bearing attached to the cross rail of the planer. With the horizontal cutting arrangement there is also an auxiliary arbor attachment driven from the main spindle by gearing for lighter milling work when higher speed is desired. The main spindle is driven by a bronze wormwheel engaging with a hardened steel worm upon the pulley shaft, the wormwheel being encased and running in oil. The thrust of the worm is taken by ball bearings. The attachment is so arranged that it may be swivelled at any angle desired.

COMBINED INTERNAL AND EXTERNAL BEAM CALIPERS.

In Fig. 4 is shown a new combined internal and external beam calipers. The internal calipering jaws are arranged above and the external calipering jaws below the graduated beam, and the scale is graduated so as to read directly, due allowance being made for the least reading, which is one-half inch. In this way there is no allowance necessary to be made for width of jaws. The scale is provided with a vernier for accurate reading. The caliper is made by E. G. Smith, Columbia, Pa.

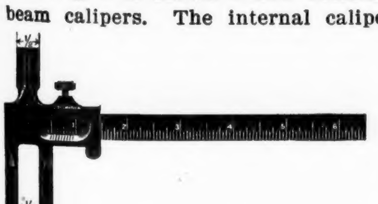


Fig. 4. Combined Internal and External Beam Calipers.

UNIVERSAL GEAR CUTTING AND MILLING ATTACHMENT FOR LATHES.

The Senaca Falls Mfg. Co., Senaca Falls, N. Y., have brought out a novel gear cutting and milling attachment for lathes. Fig. 5 shows the attachment as used in fluting reamers, taps, etc. The bracket piece holding the driving mechanism and cutter is attached to the cross feed slide in place of the tool block and the cutter is driven through a

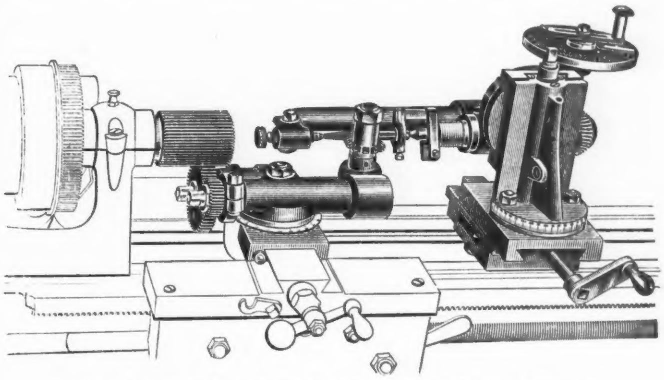


Fig. 5. Milling Attachment in Position for Fluting a Reamer.

pair of encased dust-proof spiral gears by a driving arbor, which arbor is driven through a train of gears from the head stock spindle. One of this train of gears is screwed to the nose of the lathe spindle and has a wide face so as to allow the bracket and cutter a travel of about 3 inches. The intermediate gear is on an adjustable quadrant which swivels

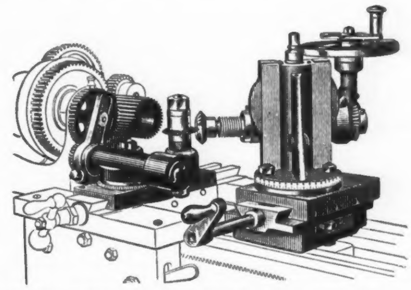


Fig. 6. Milling Attachment in Position for Cutting Bevel Gears.

on the frame piece, thus allowing a cross adjustment of the entire frame and slide rest to accommodate the cutters to the various sizes of work.

The swivel dividing head is securely clamped to the lathe bed by its base, and has cross and vertical feeds permitting of any adjustment of the work. The upright part of the dividing head swivels upon the cross feed slide, and the overhanging arm with spindle and the indexing device swivel upon the vertical feed slide, the slides being graduated, so that cuts of any angle may be made. Fig. 6 shows the attachment thus arranged for cutting bevel gears.

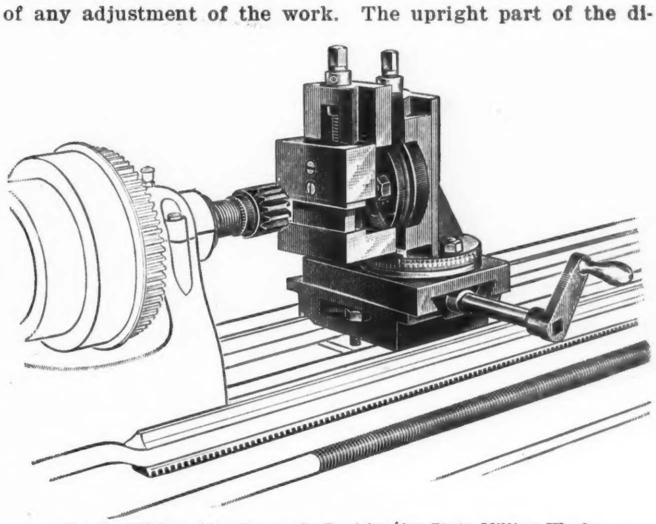


Fig. 7. Milling Attachment in Position for Plain Milling Work.

For milling operations requiring a vise, the frame piece containing overhanging arm and indexing device is removed, and in its place a vise arrangement is attached. In using this vise, the cutter may be attached directly to the head stock spindle, as shown in Fig. 7.

NEW AUTOMATIC POWER FEED TURRET HEAD.

In Fig. 8 is shown a newly designed automatic power feed turret head that has been placed upon the market by Fay & Scott, Dexter, Me. It is applicable to any lathe and is built heavy and rigid enough to handle any class of work. The tripping device is actuated automatically by a clamping button on the rod shown in front of the turret on the top slide, which button comes against the little handle at the left and pushes it down, in which position the handle is shown. This handle, working on a rod running through the turret base, throws out the power feeding gear at the position of the top slide governed by the location of the clamping button. Fig. 2 shows the arrangement of the power feed. The feeding gear is driven by a worm mounted upon a stud parallel to the feed rod, and the worm is connected to the feed rod sleeve by a pair of pinion gears.

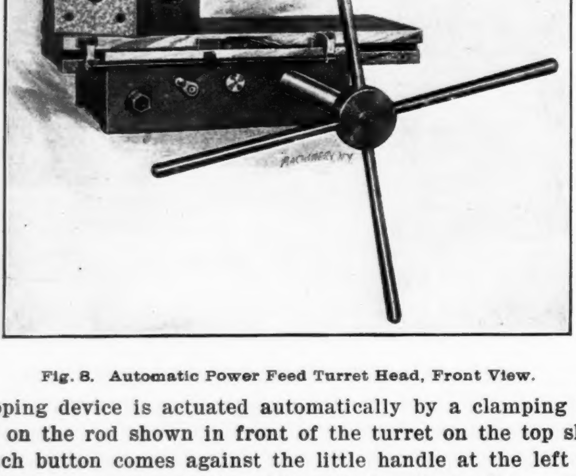


Fig. 8. Automatic Power Feed Turret Head, Front View.

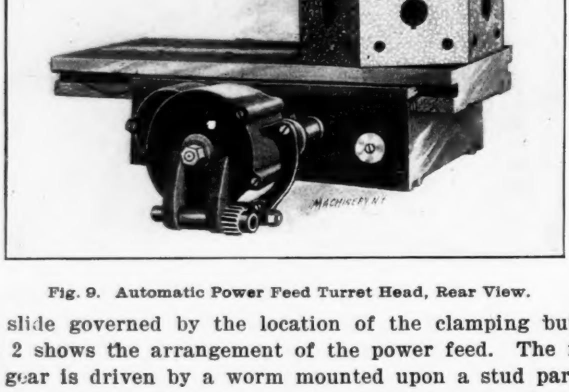


Fig. 9. Automatic Power Feed Turret Head, Rear View.

The locking pin is withdrawn from the turret by the handle shown in the front side of the top slide, coming against a pin in the base, thus throwing the handle over and depressing the locking pin, which unlocks the turret.

MICROMETER CALIPER WITH DEPTH PLUG ATTACHMENT.

A micrometer caliper with a depth measuring attachment is a novelty. The Massachusetts Tool Company, Greenfield, Mass., have perfected and are placing upon the market a micrometer with such an attachment and also a clamping device for locking the screw at any desired position, as shown in Fig. 10. The depth plug attachment consists of a steel plug fitting up through a hole in the anvil against the face of the screw, and, in using, the screw is read the same as usual, the plug simply acting as an extension of the screw downward below the flat surface underneath the anvil. The measurement thus taken is between the lower end of the plug and the flat surface below the anvil. The shell is in this micrometer graduated to half-thousandths, and the clamping device for locking the screw is operated by the knurled nut on the frame just below the barrel.

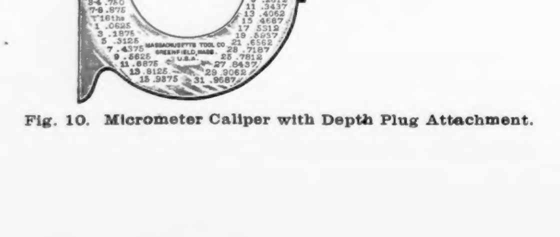


Fig. 10. Micrometer Caliper with Depth Plug Attachment.

UNIVERSAL DIVIDER.

The universal divider, shown in Fig. 11, is adapted for laying out work close to corners, as well as scribing the smallest circles. The bent adjustable scriber holder is reversible and may carry either a fine steel or pencil point. With the holder turned outward, it is possible to scribe in inaccessible corners, while with it turned inward, the points may be brought close enough to scribe the smallest circle. Two beams of different lengths accompany the divider, and also a V center point to be substituted for the regular point in scribing around drilled holes. This divider is made by the L. S. Starrett Co., Athol, Mass.

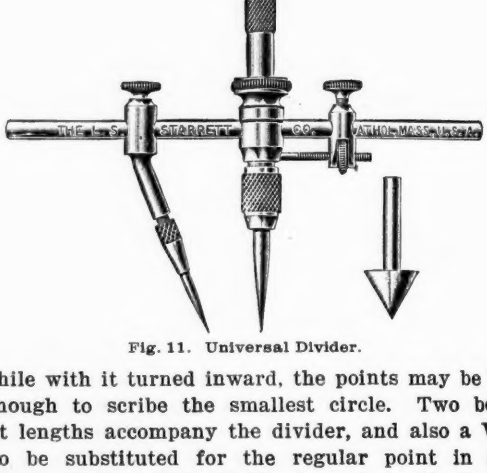


Fig. 11. Universal Divider.

TOOL-ROOM SET OF MICROMETER CALIPERS.

J. T. Slocomb & Co., Providence, R. I., have placed upon the market a complete set of twelve micrometer calipers, ranging in size from zero up to twelve inches. A rack is furnished to hold the calipers in order of sizes, as shown in Fig. 12,

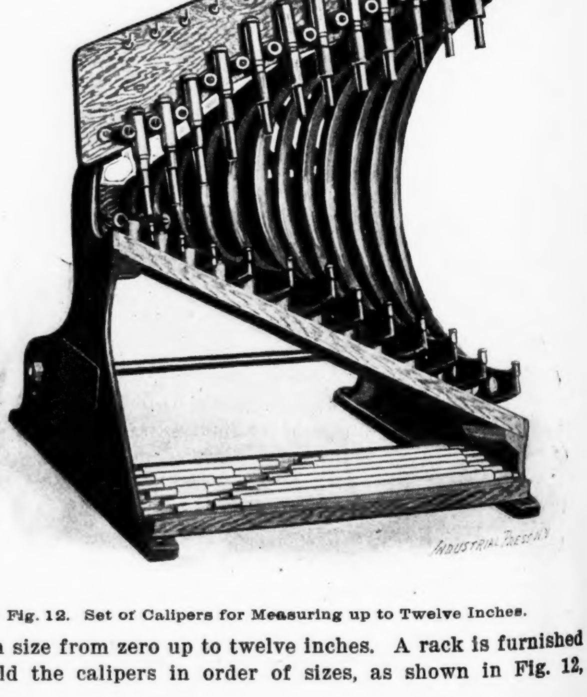
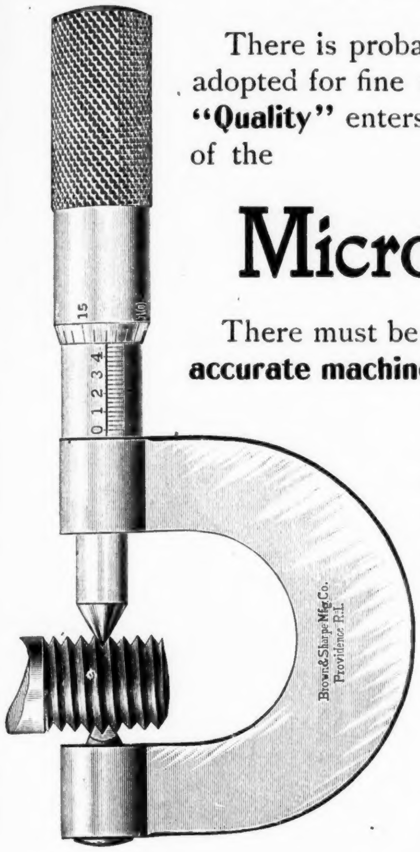


Fig. 12. Set of Calipers for Measuring up to Twelve Inches.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.



There is probably no tool that has been so universally adopted for fine measurement into which the question of **"Quality"** enters more strongly than in the construction of the

Micrometer Caliper.

There must be in the first place **skilled workmen,** then **accurate machines,** for one can readily comprehend that in manufacturing in large quantities instruments that must read within .0001 in., it becomes necessary to use in their construction still more accurate machines.

Our various styles of

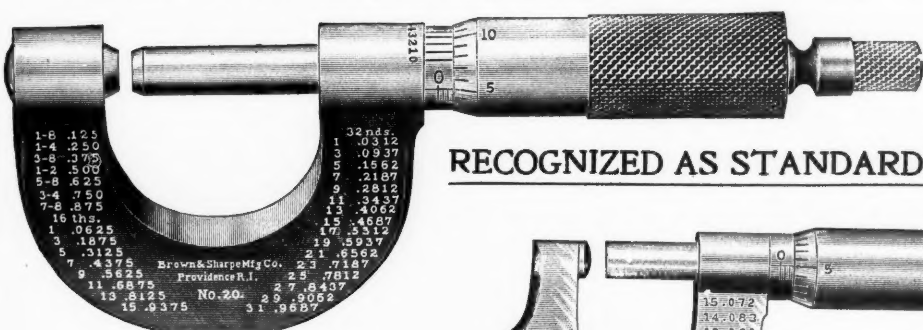
Micrometer Calipers

permit the selection of one for almost any purpose.

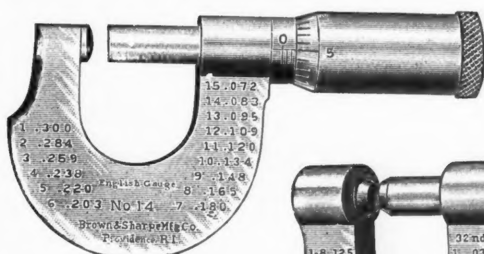
100 Different Styles in Stock.

The illustrations show a few different styles.

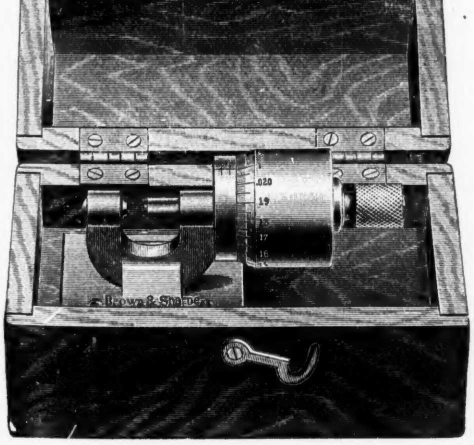
Machinists' Tool Catalogue, fully illustrated, mailed to any address upon application, gives full description of all **styles** and their **prices.**



RECOGNIZED AS STANDARDS FOR ACCURACY.



ENGLISH OR METRIC MEASURE.



Micrometers first made by us in 1867.

Hardware and **Supply Dealers** carry our tools in stock.

and, for convenience in the tool-room, there is a hook above each caliper to receive the workman's check as the tool goes out. Each caliper is non-adjustable, thus ensuring maximum accuracy, and has a range of one inch, the heads being the same on all sizes for ease of reading. The frames of the calipers of sizes from one inch to six inches are drop forgings of steel, while those of the larger sizes are steel castings with holes cast in them to make them lighter, all frames being finished in black enamel. The end measures for truing the calipers are kept in a grooved board, as shown in the lower part of the rack. The rack is very neatly finished in oak with rubber cushions for partitions between the tools.

* * *

A SWINDLER CAUGHT.

For two years or more a swindler has been collecting money from machinists and engineers, to whom he represented himself as a subscription agent for the Industrial Press; and although many complaints came to us from various parts of the Middle and Western States, we were unable to get on his track until last month, when we found he had been operating in Washington, D. C., and immediately sent Mr. C. E. Jameson, our Philadelphia circulation manager, to the former city. Mr. Jameson proved to be a first-rate detective, although this was his first experience in that line, and after three weeks' persistent work located a man named J. Hauk in Philadelphia, whom we know to be responsible for the bogus collections in Washington and Philadelphia, and believe to be responsible for those in other parts of the Middle States. Hauk was arrested and sentenced to three months in the county jail, and his sentence we hope will serve as a warning to others like him who find it easy to victimize good-natured machinists, for we shall follow them up without regard to time or expense until they are arrested.

All our authorized agents carry a complete outfit of printed receipt books and written authority to collect signed by an officer of this company, which they will show when requested. Subscribers are perfectly safe in paying money to any agent who can show this authority; but they should never pay one cent, no matter what inducements are offered, to any one who cannot show it.

* * *

FRESH FROM THE PRESS.

The Marvels of Modern Mechanism, by Jerome Bruce Crabtree. Published by the King-Richardson Company, Springfield, Mass. 750 8vo pages, illustrated. Price, cloth, $3.25.

This book is an attempt to describe in language free from technicalities a few of the most striking inventions and to show what part they have played in industrial life. It is not a technical treatise, but is rather a popular review of the century in the field of invention, intending to present the broader bird's-eye view of progress achieved. It is an interesting work and is very nicely gotten up typographically.

Electrical Designs. Reprinted from the American Electrician. Published by the American Electrician Company., 120 Liberty St., New York. 262 pages, illustrated. Price, cloth, $2.00.

It is usually difficult to obtain instructions for constructing electric motors, electrical testing instruments, and other electrical apparatus which are based upon apparatus that have actually been built and used. This book contains a series of designs for the construction of such apparatus which have been either already built and used or carefully designed to allow for the possible variations of material and results, so annoying to the amateur; and also the designs are prepared for the utmost simplicity of tools and facilities required. It is assumed that anyone sufficiently interested to attempt the construction of such apparatus will be familiar enough with mechanical details as to be able to exercise individual judgment in matters of fitting of parts and design of details, and the main effort has been put upon the more important features of electrical design. Some very interesting designs are presented, as, for instance, combined alternating and direct current dynamos, an induction motor, voltmeters and ammeters, a 5-inch spark high frequency coil, and the promising Nernst lamp. This book should be invaluable to machinists and engineers who have a desire to become familiar with electrical apparatus by the ever-fascinating method of building for themselves.

Hand Book of Practical Mechanics, by Chas. H. Saunders, Ph.B. Published by the author, at 216 Purchase St., Boston, Mass. Second edition, 1901; 227 pages, pocket size. Price, cloth, $1.25.

In this book an attempt has been made to place before the reader a very complete collection of valuable data and information for use in the machine shop. The text is profusely interspersed with tables of tap, drill, wire, sheet metal sizes, mathematical tables, etc., that machinists need, containing probably the most complete collection of this kind to be had. It is intended solely for draftsmen and machinists, especial care having been taken to simplify the rules and formulæ relating to mechanics to facilitate the work of calculation. Additions have been made in the second edition, as have been suggested from time to time, without altering its condensed form. The arrangement of the numerous tables, explanations, etc., is not systematic, although a very complete alphabetical index is provided.

Practical Electrical Testing in Physics, and Electrical Engineering, by G. D. Aspinall Parr, Assoc. M.I.E.E. Published by Longmans, Green & Co., London and New York. 392 8vo pages, illustrated.

This work is intended to form a systematic course of instruction in electrical testing in connection with the studies of physics and electrical engineering. It is in no wise a beginner's text-book, as it involves considerable higher mathematics. For students in engineering colleges, it is, however, an excellent hand-book, as not only the apparatus needed and observations to be taken in the various tests, but also the inferences to be drawn therefrom. Appendices are added containing advanced tests and also detail descriptions of the standard electrical testing instruments in use.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Nicholson File Co., Providence, R. I. Price list of Swiss Pattern Files applying to their X.F. and Gold Medal brands.

The Winkley Company, Hartford, Conn. Catalogue of oil hole covers in plain and self-closing dust-proof types.

American Blower Co., Detroit, Mich. Sectional catalogue No. 118, descriptive of the "A.B.C." system of mechanical draft, both forced and induced, and machinery necessary in operation of same.

The New Britain Machine Co., New Britain, Conn. Catalogue of machine shop furniture, including tool racks, lathe pans, shelving, etc., in different styles and sizes.

Whitcomb Mfg. Co., Worcester, Mass. Circulars of power shears, presses, punches, and cutting-off presses; and hand shears, punches, and plate-bending rolls.

Becker-Brainard Milling Machine Co., Hyde Park, Mass. The Pan-American catalogue of vertical and horizontal milling machines, and automatic gear cutting machines.

Laminar Fibre Co., North Cambridge, Mass. Catalogue of laminar fibre box and can specialties, with special reference to fibre pinion or gear blanks.

The Garvin Machine Co., Spring and Varick Sts., New York. Circular of two-spindle and one-spindle profiling machines, and duplex milling machines.

Joseph T. Ryerson & Son, Chicago, Ill. Catalogue of the Lennox rotary bevel shear, with full description, and also the Lennox rotary splitting shear.

Watson-Stillman Company, East 43d St., New York. Catalogue No. 61 of hydraulic jacks, showing several new types. General directions for handling the jacks are also given.

The Garrard Manufacturing Co., (Ltd.,) Birmingham, England. A catalogue of bicycle construction, including bicycle chains, hubs, cranks, etc., and special tools for fitting.

Prentiss Vise Co., 44 Barclay St., New York. Catalogue No. 47 of self-adjusting jaw and solid-jaw vises, jewellers' vises and anvils, bicycle vises, pipe vises, and attachments.

Springfield Mfg. Co., Bridgeport, Conn. Catalogue of special grinding machinery, automatic dry, knife and tool grinders, and emery and corundum wheels.

Norton Grinding Co., Worcester, Mass. Catalogue descriptive of heavy 18 x 96 plain grinding machine and showing cuts of both straight and taper work done by it. This machine and its possibilities were fully described in the June number of this paper.

Edwin Harrington, Son & Co., Inc., Philadelphia, Pa. Catalogue of machine tools, including heavy lathes roll grinding machines, extension lathes, single and multiple drills, planing machines, etc., and also chain hoists, overhead tramways, cranes, and gearing.

Cataract Tool & Optical Co., Buffalo, N. Y. Catalogue of precision lathes and attachments. Lathes are shown in all styles, as plain speed lathe, with slide rest, screw cutting attachment and milling attachment.

Joseph Dixon Crucible Co., Jersey City, N. J. A very artistic catalogue with illustrated views of their mines, their works, methods of manufacture and productions. The company has graphite mines at Hague, N. Y.; Graphite, N. Y.; and their main works are at Jersey City, N. J. Their products are graphite crucibles, retorts, brazing crucibles, plumbago facings for foundries, graphite lubricants, axle grease, graphite paints, belt dressings, lead pencils, and various other articles.

MANUFACTURERS' NOTES.

The Burt Mfg. Co., Akron, O., inform us that they have recently equipped the San Juan Light & Transit Co., Porto Rico, with Cross oil filters.

The Newton Machine Tool Works, Philadelphia, Pa., announce that their president, Mr. Chas. C. Newton, is at present in Europe on his annual trip to attend to the foreign interests of the company.

The Higley Machine Co., Croton Falls, N. Y., has just been formed, to take over the business of the Higley Sawing & Drilling Machine Co. The products of the Higley Machine Co. are handled by the J. R. Vandyck Co., 136 Liberty St., New York.

The American Blower Co., Detroit, Mich., recently closed a contract for the heating, ventilating, drying and mechanical draft plants for the new works of the New York Glucose Co. now being erected at Shady Side, N. J.

The Jeanesville Iron Works Co., Jeanesville, Pa., and Denver, Colo., have sent us a copy of their advance sheet No 10 which treats of the Jeanesville triplex electric pump having three acting plungers operated by a countershaft, with cranks set 120 degrees apart.

The International Correspondence Schools, Scranton, Pa., inform us that a course in drawing, designed to meet the requirements of teachers, has recently been prepared, which will qualify teachers not only to pass the examinations necessary to secure teachers' certificates, but also to fill positions as instructors in drawing.

The Northern Electrical Mfg. Co., Madison, Wis., through its Chicago office, recently secured the contract for the entire equipment of the new central station of the Citizens' Electric Light Co., Battle Creek, Mich., and also one from the L. Wolff Mfg. Co., manufacturers of plumbers' supplies, for a complete equipment of generators and motors for their large works in Chicago.

The C. W. Trainer Mfg. Co., Boston, Mass., have received recently a number of testimonials with regard to their Olympia Asbestos-Metallic packings. Among the various firms who expressed themselves as satisfied with these packings were: The Starr Piano Co., Richmond, Ind.; Shelly & Brother, Holgate, O.; Kelley Island Lime & Transport Co., Marblehead, O., and others.

The New Process Raw Hide Co., Syracuse, N. Y., report the recent shipment of 100 electric railway pinions for G. E. 800 motors to London. A shipment has also been made to the Albion Motor Co., an English firm. A number of large bevel gears, both iron and raw hide, have been recently shipped to an English shipbuilding concern, and a number of railway pinions to Germany and Norway.

The Standard Tool Co., Athol, Mass., announced that their shops went on the 9-hour day with 10-hour pay schedule June 1. At the time the announcement was made, the probabilities were that the shops would be run 10 hours per day and the men receive a corresponding increase in pay, since they are extremely busy and have not room for more men. The action of the company was entirely voluntary, and naturally will receive the approbation of their employes, as they were already a well-paid class of workmen and have been steadily employed at full time for the past two years.